Exploring Limits

Making Decisions About the Use & Development of Maine's Islands

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Printing: Letter Systems

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The Nature Conservancy: p. 34
National Park Service: p. 35

Exploring Limits: Making Decisions About the Use & Development of Maine Islands was produced by the Maine State Planning Office with funding provided by the U.S. Department of Commerce, Office of Ocean and Coastal Resource Management, under the Coastal Zone Management Act of 1972, as amended. Printed under appropriation number NA27 0Z0310-01.

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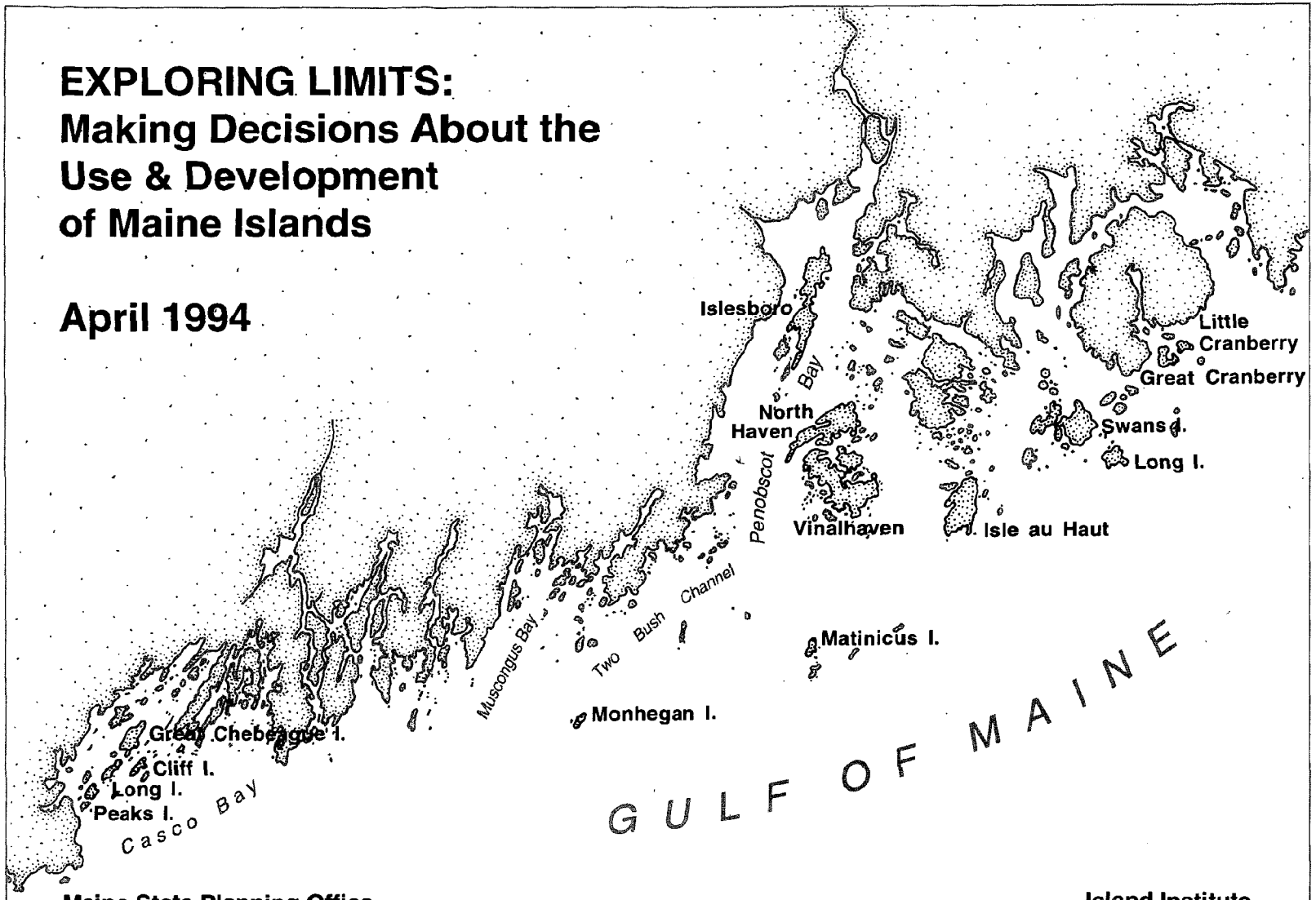
April 1994



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ACKNOWLEDGEMENTS

Holly Dominie of H. Dominie, Inc. of Manchester, Maine, researched and wrote the text of this publication.

Katrina Van Dusen of the Maine State Planning Office conceived of this project, directed its progress, and edited the text. Annette Naegel of the Island Institute provided considerable data and resources. Cynthia Bourgeault edited some of the text. Anne Hayden gave continuing support. Carol Shaw's earlier work on island carrying capacity provided direction for this project.

Many other people, hopefully none forgotten here, contributed rules of thumb or information. They include:

John Albright and Fran Rudoff , Maine Dept. of Economic and Community Development
Brad Allen and Gary Donovan, Maine Dept. Inland Fisheries and Wildlife
Raquel and Peter Boehmer and Bill Payne, Monhegan
Jerry Bley, Creative Conservation
Sarah Brusila, Land Use Regulation Commission
Laura Cabot-Carrigan, Bill Ferdinand, and Richard Sherwood, Maine State Planning Office
Steve Davis and Dave Getchell, Maine Island Trail Association
Orlando Delogu, University of Maine School of Law
Judy Dunah and Helga Houmere, Monhegan Associates
Rob Elder, Maine Dept. of Transportation
Jim Fox, Friday Harbor, Washington
Robert Gerber, Lissa Robinson, and Andrews Tolman, Robert G. Gerber, Inc.
Ron Gordon, Friday Harbor, Washington
Jim Hatch, affordable housing consultant
Rick Knowland, City of Portland
Raymond Leonard, Sterling College, Vt.
Burnham Martin, National Park Service
Jean Martin and Robert Peterson, Maine Dept. of Human Services
Mike Parker, Steven Pinette, Maine Dept. of Environmental Protection
William Perkins, Applied Wastewater Technology, Inc.
Ron Poitras, Hancock County Planning Commission
Rick Rogers, Town of Islesboro
Matt Scolnikoff, Town of Isle au Haut
John Spear, Town of Vinalhaven
Steve Spencer, Maine Dept. of Conservation, Bureau of Public Lands
Barry Timson, Timson and Peters, Inc.
Rachel Therrien, Maine Waste Management Agency

Everyone's help is gratefully appreciated.

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Dear Reader,

Maine's coastal islands are special places to many of us—whether you live on one, are a regular or occasional visitor, or enjoy them from afar. These islands constitute a unique natural and cultural resource of state and national significance. However, people are concerned that the variety and intensity of human activities on and around the islands are beginning to threaten fragile island ecosystems and the unique quality of island life.

Exploring Limits: Making Decisions About the Use and Development of Maine Islands is intended to be both a primer on understanding the limits on use and development of islands and a how-to guide for assessing certain elements that make up an island's carrying capacity. We hope the publication will be interesting for people who haven't thought much about the limits of an island's natural resources, and useful for those who are working to assure that critical island resources are adequately protected as islands are used and developed.

The publication is designed for people in island towns and towns with offshore islands, the State Land Use Regulation Commission, which regulates land use on several hundred islands, and communities and individuals considering long-range plans for a single island. People living in other coastal areas, particularly those on Maine's coastal peninsulas, should also find it relevant. It can be used as a specially-tailored guide to comprehensive planning for islands.

The Maine State Planning Office and the Island Institute collaborated to produce this handbook, part of a bigger island project, initiated in 1992 by the State Planning Office. The goals of the Islands Project are to provide information to island residents and visitors that will enable them to make decisions that guide future island use and development in a manner that is sensitive to an island's natural resource limitations, and to pursue changes to state laws and policies so that they better consider the unique values and constraints of islands.

We are interested in feedback about how this handbook was useful to you.

Sincerely,

Katrina Van Dusen
Maine State Planning Office

Annette Naegel
Island Institute

April 1994

ISLANDS ACCENTUATE LIMITS

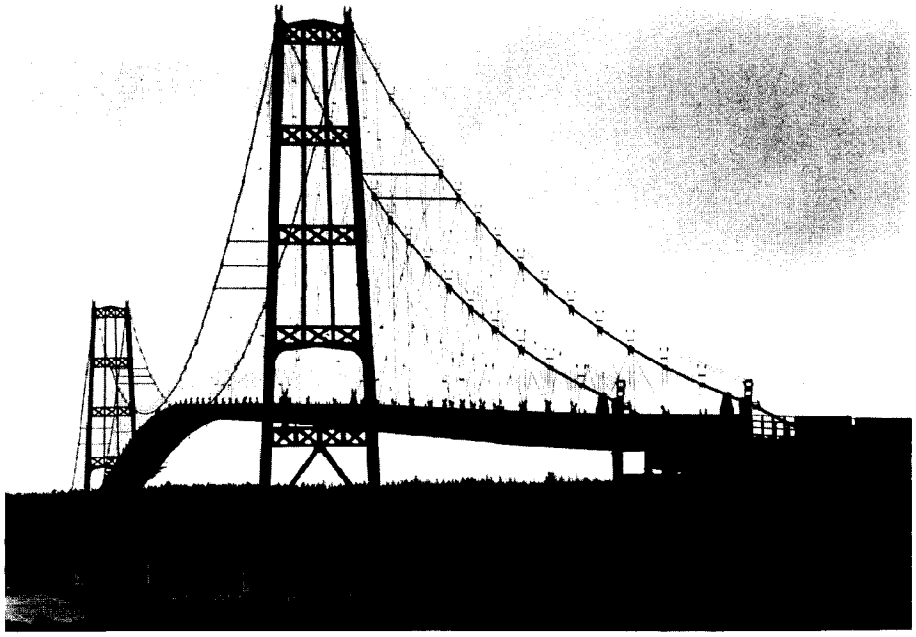
The Maine Islands

The Maine islands are a treasure of national and international significance, an integral part of the beauty and richness of our coast. The State's Coastal Island Registry counts 4,617 islands, including ledges exposed at high tide. Another inventory identified 1,149 islands of over 10 acres in size. However, people use a variety of estimates to describe how many islands there are, who owns and uses them, and who has jurisdiction over them; the lack of definitive information about numbers of islands and their ownership adds to their mystique.

Fourteen of the islands have year-round populations; a few more have a family or two living on them all year; roughly 30 have summer communities; quite a few more have one to a few seasonal residences. The majority of Maine's islands have no human habitation; many of these are important habitat for seabirds.

The State owns 1300 islands, although many of these are ledges. A small number, less than 50, are owned by federal agencies, towns and private conservation organizations. The rest are privately owned.

The vast majority of the islands are under the jurisdiction of a mainland municipality, including the year-round communities on Peaks, Cliff and Chebeague Islands. Three hundred and six islands are unincorporated, falling under the jurisdiction of the State Land Use Regulation Commission, including Monhegan and Matinicus. There are eight island towns including the Cranberries, Swans Island, Frenchboro, Isle au Haut, Islesboro, North Haven, Vinalhaven, and Long Island, and the islands that surround them.



More than two dozen islands along the Maine coast are linked to the mainland by a bridge, like this bridge to Deer Isle. This handbook focuses on islands that do not have bridges.

Clearly there are myriad differences between the islands of Maine's archipelago when it comes to size, habitation, ownership, or governance, but their similarities are equally striking—they are all rocky outcroppings in the sea. They are covered with a minimum of soil. Fresh water supplies are limited. Unique plants and wildlife are abundant. Scenic beauty abounds. Their many common geological and ecological features make Maine islands similarly fragile and vulnerable to harm from unlimited use and development.

Islands Accentuate Limits

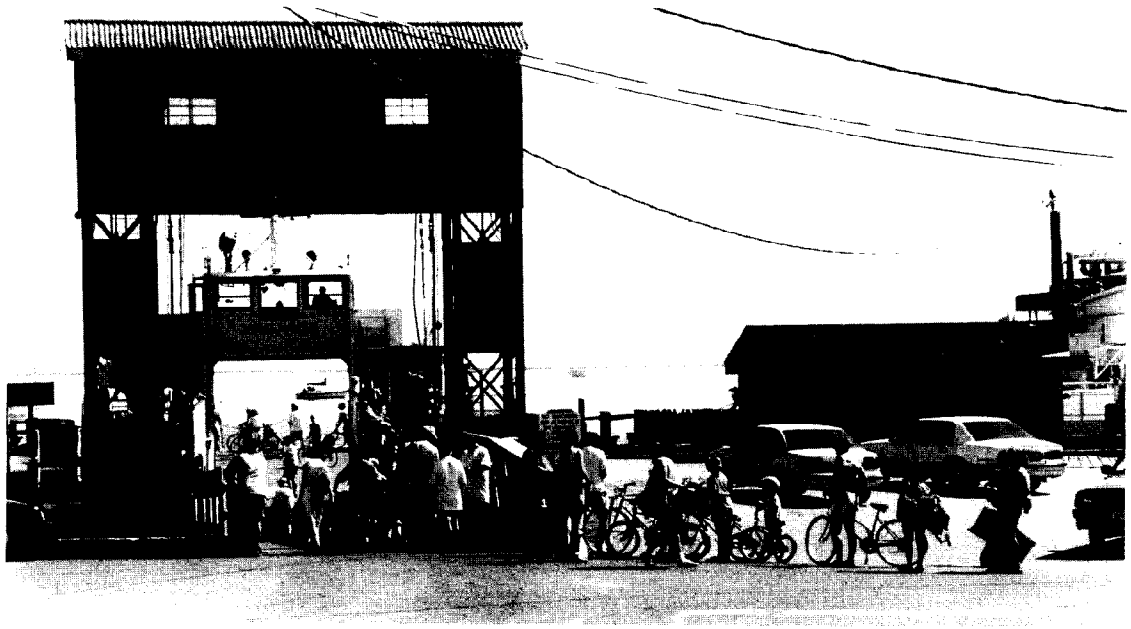
As all islanders know, both the charm and the challenge of island living are imposed by the island's distinct geographical boundaries. The surrounding barrier of the sea means that essential goods and services not available on the island must be transported by boat or plane, creating additional expense and delay. Groceries, building supplies, heating oil, the mail: all these must travel onto the island, while many islanders head off to the mainland for medical appointments, major shopping, entertainment, and other specialized needs. On all but the three largest of the year-round island communities, students must commute to the mainland for high school.

Even more significant, from a planning standpoint, islands accentuate limits because the amount of land is finite, and other natural resources can be depleted. Uses can conflict quickly, more so than on the mainland. Runoff from a poorly-placed septic system can pollute the clamflats on which islanders are economically dependent. A leaking landfill can contaminate the drinking water for the entire island. Skyrocketing real estate prices can drive working islanders off the island. Intensive recreational use of an uninhabited island can destroy vegetation or disrupt nesting seabirds. On islands, once a limit is exceeded, the damage is often irreversible.

The Island Population Explosion

Like most of the Maine coast, the islands have become popular places. Ironically, while the 14 fulltime island communities struggle to maintain their year-round populations, nearly all the islands have witnessed dramatic increases in seasonal visitation. Figures from nine of these islands show a combined increase of 404 vacation homes during the 1980s, resulting from both new construction and the conversion of year-round homes to seasonal use. Population on the year-round islands routinely doubles or triples in the summer, and in some cases increases even more.

But even seasonal, "second-home" use patterns do not give the full picture of this dramatic increase in popularity. The islands are also being visited in unprecedented numbers by daytrippers and other short-term visitors. Passenger and vehicular traffic on the Maine State Ferries (serving Swan's Island, Frenchboro, North Haven, Vinalhaven, Islesboro, and Matinicus) increased by approximately 50% between 1982 and 1992, and the number of bicycles (bearing seasonal daytrippers) nearly doubled—up 93%. Ridership on Casco Bay ferries also increased during the decade at an overall rate of about 33%. During the peak summer months, passenger totals on these lines routinely double. (For more information on population, housing and ferries, see Appendix 4.)



In the last decade, biking has grown in popularity with island visitors. Between 1982 and 1993 the number of bikes carried on State ferries increased 93%. These people are waiting on the pier in Rockland to board the Vinalhaven ferry.

How Much is Too Much?

This is the question increasingly being asked by island residents and owners, island planning boards, and even the visitors themselves. There's a subjective element, of course: if you're used to being the only one on the beach, it feels crowded when one other family shows up. But aside from that kind of intuitive reaction, are there *actual physical limits* beyond which an island's capacity to absorb this increase in users can no longer be stretched? From around the islands there are many signs for concern:

Recreational boat traffic has also increased substantially. With the growing popularity of sea kayaking and small boat cruising, some boaters have experienced increased competition for favorite picnicking and mooring spots and greater traffic along the most popular travel routes. A 10-year-old Island Institute study showed recreational boat usership remaining fairly constant between 1979 and 1981, then jumping dramatically—doubling, in fact, in 1982 and 1983. In 1993, the Maine Island Trail Association began a three-year study monitoring recreational use of 27 islands. The study's results showed a 25% increase in the number of boats visiting the islands over the 10 years since the last survey.

• On Swan's Island, residents became concerned during the building boom of the late 1980s when many island wells began going dry or experiencing salt water intrusion as new wells were added at an average rate of 15-20 per year. A Water Committee was established by the Planning Board to study the island water table and wetland "recharge areas," to determine if protective zoning measures were needed.

• Islesboro is faced with a safety problem created by the growing number of bicyclists on its narrow, winding roads. There were a number of accidents during the 1992 and 1993 seasons, in some cases necessitating emergency runs to mainland hospitals.

Use of Maine islands by sail and motor yachts, sea kayakers and other small boats has increased steadily over the last 15 years. The Maine Island Trail Association was formed in 1987 to develop and maintain a 325-mile-long waterway, promoting thoughtful use and volunteer stewardship of the islands on the trail by recreational boaters.

• Responding to increased numbers of daily visitors, which in peak season are estimated on some days to exceed 200, Monhegan residents have begun to question how many off-islanders the community can absorb each day without seriously stressing the water supply, natural environment, and public services—not to mention the special character of island life.

• Wildlife biologists are concerned about the effect of proposed residential development on the north end of Metinic Island in outer Penobscot Bay, an important habitat for eiders, arctic terns, black guillemots, herring gulls and black-backed gulls.

• The 1993 Maine Island Trail Association survey of recreational island use indicated that a few islands are used intensively; in the survey of 27 islands from Casco Bay to Blue Hill Bay, one half of all the boats observed in the survey visited Jewell Island in Casco Bay. The majority of the boats (71%) visited only four islands. Conflicts between local people and recreationists have been reported on Crow Island in Muscongus Bay. In July 1991, police barricaded Cow Island in Casco Bay at the request of its exasperated private owner to prevent repeated "trashing" by weekend revelers.

Help in Setting Limits

The concept of a *quantifiable carrying capacity* may seem like a fairly new notion when applied to island growth management and planning. But it's a well-established principle of ecology, the branch of science that deals with how populations interact within their environment. And in fact, that is what we're really talking about when we start to raise concerns about how many people an island can accommodate.

According to this principle, populations of species in any given environment are limited in size by the amount of habitat, food, water, and other survival requirements available within the confines of that environment. Ultimately,

population size is determined by the factor which is the most crucially limited—i.e., if there is no drinking water, the environment becomes uninhabitable even if there is adequate soil and vegetation. The combined impact of these factors defines the carrying capacity: a specific, quantifiable upper limit to the size of the population that environment can support.

Here the concept of carrying capacity is applied to human populations on small, finite habitats such as islands. The discussion of limiting factors falls into five general categories, including cultural as well as ecological considerations:

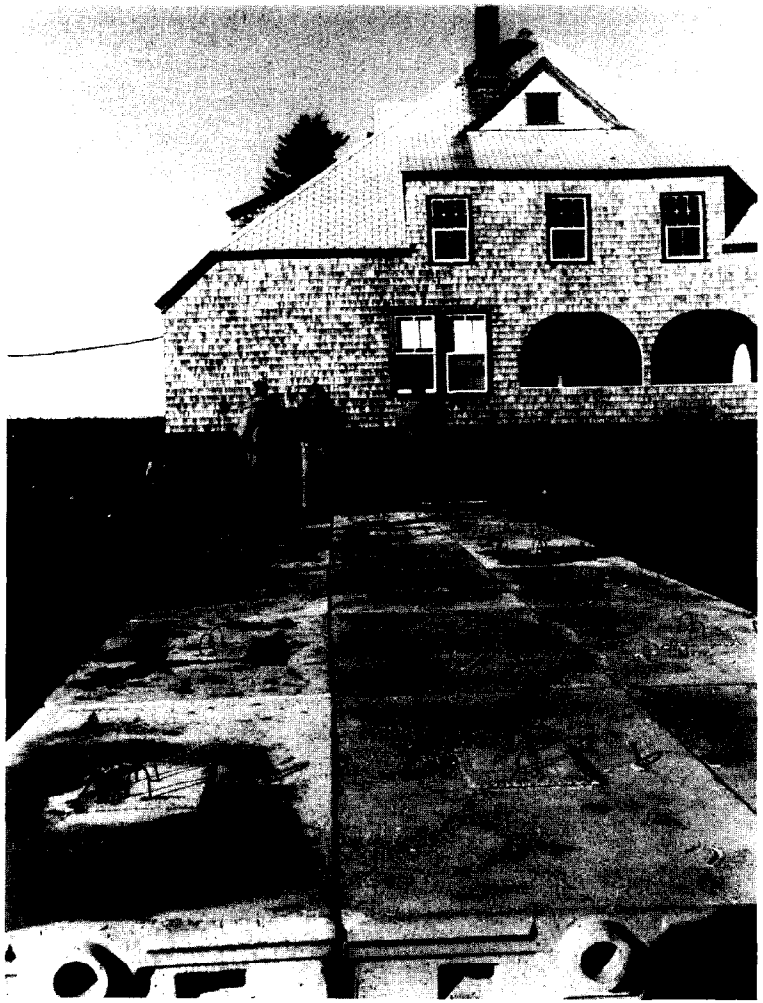
1. **HABITAT**: How many people can be accommodated without disrupting natural populations of plants and animals, especially sensitive or rare species?

2. **PHYSICAL SPACE**: How much traffic will the roads hold safely? How many structures can be built on the land that is appropriate for development?

3. **ENVIRONMENTAL**: How many people will the available water supply accommodate? How much waste can be accommodated without contaminating the environment?

4. **AESTHETIC/EXPERIENTIAL**: How many people can occupy a remote island at one time without destroying the sense of solitude for all? How many tourists can an island community absorb without feeling invaded? How much visible shoreline development can an island absorb without losing its "remote and unaltered" visual appeal or historical character?

5. **FISCAL/TECHNOLOGICAL**: How much money or technology is available or desirable to make it easier to accommodate greater numbers? (The more there is available, the more likely that carrying capacity will be a fluid number.)



Technological fixes, like this sewage treatment system being installed on Squirrel Island, can mitigate existing environmental problems, and in some cases expand an island's carrying capacity by providing infrastructure to accommodate more homes or businesses.

Although specifics vary from island to island, concern about any of the following factors can move islanders to undertake a thoughtful examination of carrying capacity:

- Amount of developable land available (i.e., places without steep slopes, wetlands, or fragile habitats
- Amount and quality of freshwater supply
- Sewage treatment capacity
- Transportation facilities for carrying/landing freight and passengers
- Island road systems
- Sensitivity of ecosystem, natural communities, or species
- Island character
- Availability of public facilities (parking, recreational facilities, harbor facilities, public toilets)
- Amount of open space
- Availability of housing, especially at affordable prices
- Management alternatives for solid waste

Using Carrying Capacity as a Planning Tool

The carrying capacity approach to planning is not new, but it is only beginning to be applied extensively in Maine. Until recently land and islands were relatively inexpensive and uncrowded. But now mounting pressure on the resources is testing limits and calling for a more thoughtful and objective accounting of the limits to development and use of Maine's offshore islands.

For town planners and concerned citizens, the carrying capacity approach offers three powerful advantages:

1. ***IT IS EMPIRICAL.*** It begins by gathering data—six specific categories are explained in detail in the next section of this handbook—rather than from subjective opinions and foregone conclusions.

2. ***IT IS OBJECTIVE.*** Opinions can be reality-tested against solid data, not mere rumor or opinion.

3. ***IT SERVES AS A BASIS FOR INFORMED, OPEN DECISION-MAKING.***

The approach suggested in this handbook is quantitative, to the extent that "rules of thumb" are available to help establish limits for growth. It should be emphasized, of course, that these are not ironclad figures, but rather, suggest a range which in turn depends on the initial assumptions made. Islanders, island owners, and policy makers for the offshore islands need to understand the implications of policy choices they make and decide on a case-by-case situation how much change is ultimately acceptable.

Empowerment of islanders, island owners, and others with jurisdiction over islands comes from having the courage to suggest that an island has quantifiable limits to growth, and the patience to engage in the process of determining what these limits may be. The consequences of failing to recognize these limits will irrevocably and unnecessarily change the islands as we now know them.

Carrying capacity analysis is a powerful tool that can help—if islanders have the political will to use it.

An assessment of an island's carrying capacity can be used by a community in making decisions about appropriate limits on growth.

LOOKING CLOSELY AT SIX LIMITING FACTORS

This chapter provides guidance for assessing the carrying capacity of several discrete island attributes or resources and "rules of thumb" for living within the limits of those resources to accommodate change. The "rules of thumb" included are a best assessment for the moment, but they could be constantly revised in response to experience, experimentation and research. These include groundwater, social experience, vegetation and soil resiliency, nesting habitat, and scenic quality. Quantitative limits are probably most readily available for these because they tend to draw the most concern. Some islands may have different or additional resources whose carrying capacity should be considered in designing a strategy for managing the impacts of use and development. This chapter also examines the issue of solid waste because of its priority among state concerns.

Groundwater

Limits and Threats

Freshwater supply is a critical factor limiting the development of offshore islands. Most islands depend upon local groundwater to meet their needs, relying primarily upon bedrock aquifers. Where soils are deeper, many islanders use dug wells, but the trend is toward drilled wells.

A few island communities have water supplies from sources other than bedrock aquifers. For instance, Peaks, Great and Little Diamond, and Cushing Island in Casco Bay tap into the Portland Water District system. Monhegan has a sand and gravel aquifer large enough to supply a community system. Public systems on Vinalhaven and North Haven depend upon freshwater ponds.

Monhegan aquifer reaching capacity

About 10 miles offshore of Port Clyde in Knox County, Monhegan Island is home to 450 residents (about 80 stay year-round) and up to 200 or more daytrippers who visit each day during the summer. The island, under a square mile in size, is noted for its outstanding scenery, artists' studios, grand old hotel, and traditional architecture.

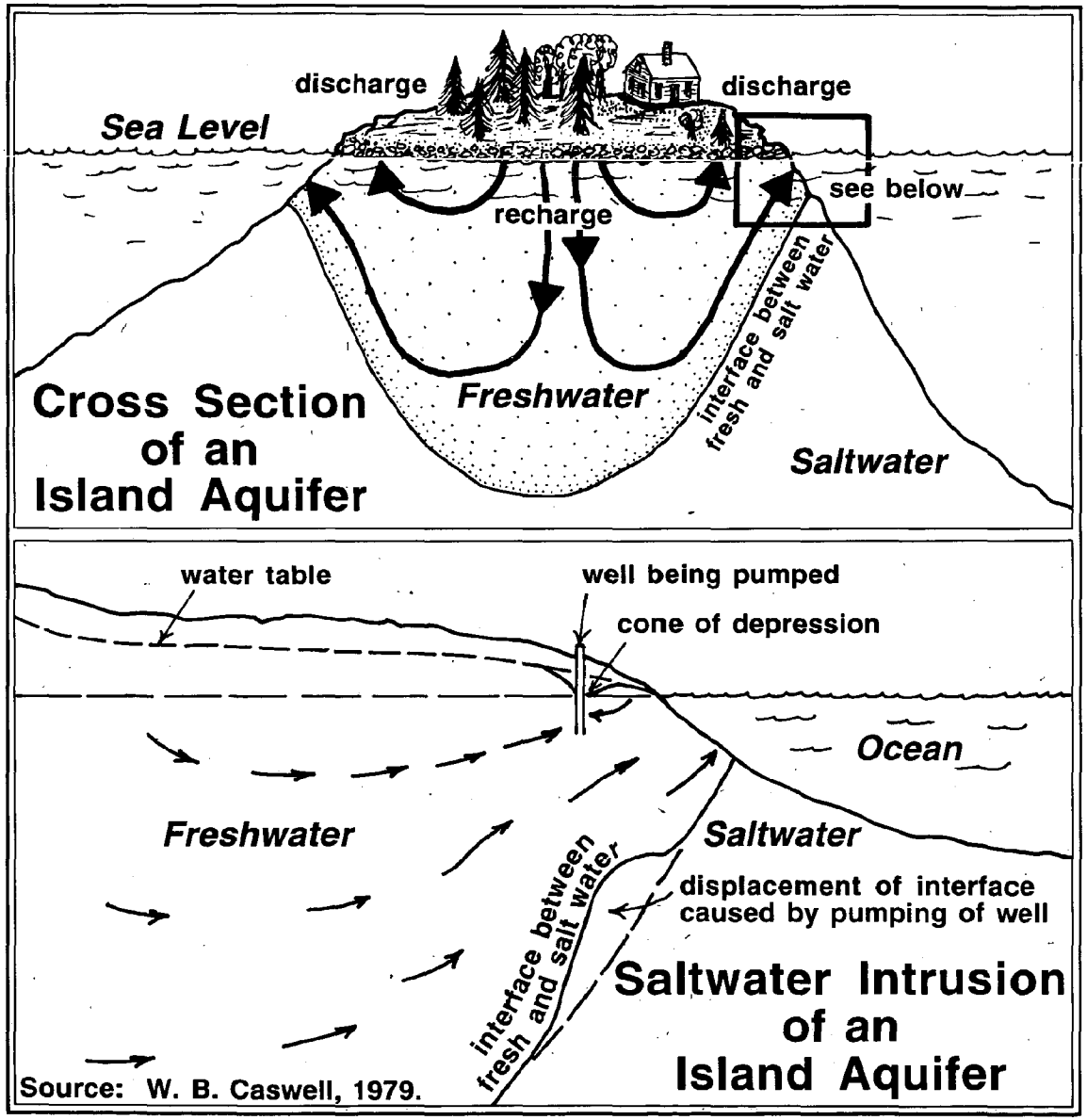
From May to November, the community relies almost solely on a chlorinated water supply from a sand and gravel aquifer beneath "The Meadow," a bog wetland lying within the heart of the village. The rest of the year, residents make do with drilled wells, dug wells, and cisterns. Businesses use saltwater and stream flow to supplement their water supplies.

A 1989 study by Timson, Schepps & Peters, Inc. found that the aquifer can theoretically support another 200 individuals under average recharge conditions. This assumes that each resident consumes 40 gallons per day over the 3-month summer season. However, there have been water shortages in recent years because the present water delivery and storage system is incapable of meeting water demand in a dry summer. The question remains, could the aquifer provide for the additional demand under drought conditions, if the delivery system were upgraded, without inducing saltwater intrusion?

If it wasn't for the fact that freshwater is lighter than saltwater and floats upon it, drinking water would be scarce on islands. Fortunately, between 5 and 10% of the annual rainfall seeps into the cracks in the bedrock or into the thicker, more permeable soils to replenish the store of groundwater found in the bedrock below. More recharge occurs in the interior parts of an island than at the perimeter.

The precipitation that gets into the ground recharges a lens-shaped body of freshwater that sits under the surface of most islands. This "lens" is usually deepest under the center of an island and tapers to meet the sea below the high tide line. The freshwater saturating the bedrock literally floats upon the saltwater underlying and surrounding it. The groundwater entering the bedrock moves through fractures in the rock. It travels down into the lens in the interior as "recharge" and up toward the surface at the edges of the island where it is "discharged" into the ocean.

Groundwater supply can be meager on coastal islands, depending upon the permeability of the local



bedrock and depth of soil cover. When a favorable system of fractures is lacking, bedrock cannot store much water. Furthermore, the thin soil cover of islands limits the amount of precipitation that can seep into the ground. Thin soils become quickly saturated so that most rain and melted snow tends to stay on the surface, running directly into streams and the ocean.

Groundwater quality on coastal islands is particularly susceptible to contamination for two reasons: inadequate soil cover and saltwater intrusion. Thin soils are not effective in filtering out harmful bacteria and metals in subsurface sewage system effluent, household wastes, and stormwater runoff because they have limited soil particle surface area on to which these contaminants can adhere. Groundwater can also be contaminated by encroachment from the sea through saltwater intrusion. Areas where development is already concentrated, such as village areas without public water supply or sewage systems, are especially vulnerable.

Groundwater supplies deserve respect since, once contaminated, they are highly expensive and difficult to clean; and on islands, they are usually the only potable water supply available. Unfortunately, contaminants usually take several years to reach a well. By the time a pollution source is detected and stopped, a substantial amount of groundwater contamination may have taken place.

The State has petitioned the U.S. Environmental Protection Agency to designate the groundwater on several islands as "sole source aquifers." Under the federal law, these communities have an aquifer "needed to supply 50 percent or more of the drinking water" for the island and there is no reasonable alternative source to replace the water supplied by the aquifer, if it were to be contaminated. The petitions for sole source status include estimates of the enormous cost to pipe water to each of the islands from the mainland. To date, the program is in force on Monhegan, Vinalhaven, and North Haven. It is pending on Islesboro, Matinicus, and Swan's Island. Frenchboro declined to participate.

The federal program, however, really accomplishes little beyond the important step of recognizing the fragility of sole source aquifers. Basically, it allows the EPA to review federally funded projects to see that they don't harm these aquifers, and to raise public awareness about the need for protecting them.

More assertive steps need to be taken to make real gains in assuring the protection of groundwater quantity and quality on islands. The following sections describe some useful carrying capacity rules of thumb primarily developed by Robert G. Gerber, Inc. The reliance upon Gerber's findings in this handbook reflects the great number of studies the firm of consulting geologists has conducted over the years for Maine islands.

Groundwater quantity

Only so much water can be taken out of an island's bedrock "aquifer" without exceeding the amount of water from precipitation that replenishes it. The amount of precipitation that finds its way into the bedrock depends upon the island's size, bedrock characteristics, and soil cover. While sand and gravel allows 40-50% of the annual precipitation to

infiltrate the ground, on islands hydrogeologists estimate that only about 5-10% of precipitation reaches the groundwater supply.

Limits: The most important step in safeguarding groundwater supply is to ensure that enough terrain is left in its natural state to allow rainfall to infiltrate the ground. By limiting the amount of impervious surface (e.g. roads, parking lots, and buildings) to 25% of an island's land area there should be no reduction in the groundwater recharge rate.
On islands more than 100 acres in size, which are more likely to have thicker and more permeable soils, at least in certain locations, a maximum density of one acre per unit is recommended to maintain adequate groundwater quantity, providing that 75% of the island's terrain is left undisturbed. On narrow peninsulas, smaller islands, or where water supply is known to be limited, such as on parts of Swan's Island, an overall residential density, island-wide or in a particularly sensitive area, of no greater than 2.5 acres per unit should ensure that all available runoff is captured to recharge the water supply. To more specifically address carrying capacity, communities may want to vary the lot size based upon specific geologic settings of different parts of their island. The table on page 18 provides guidance for site specific planning.

Limits on water consumption are advised where supply is limited and pressurized water pumps are used. As a general rule, especially in shoreland areas, the greater amount of water pumped by each household or business, the fewer number of households that can be accommodated.

Groundwater quality

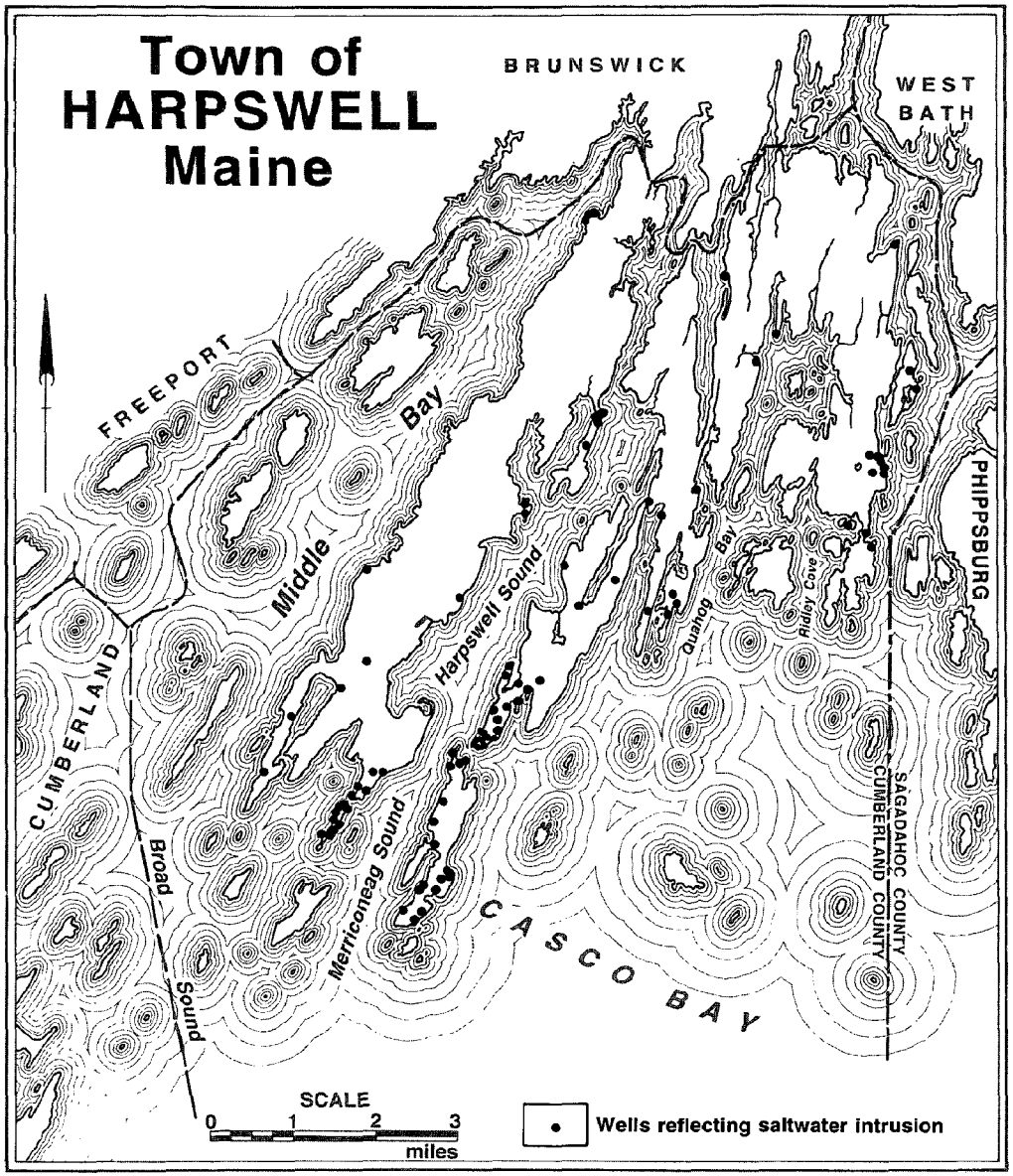
Saltwater intrusion. Saltwater intrusion occurs when too many wells are located or drilled too deep in a shoreland area — the area where the freshwater lens thins out. When water is withdrawn from them faster than they are replenished or if the wells are drilled deeper than the freshwater lens, saltwater is drawn into the wells. Saltwater intrusion may also occur in some wells located a considerable distance from the shore because of interconnected fracture patterns in the bedrock.

Saltwater is unhealthy to drink and corrodes plumbing fixtures. Wells contaminated by saltwater need "rest" in order to rejuvenate, i.e. pumping or drought conditions need to stop so that fresh groundwater can be replenished. The time for recovery depends upon the porosity and recharge rate of the aquifer and the amount of rainfall.

People like to be near the shore. Because most development occurs around the perimeter of an island, the likelihood of saltwater intrusion increases with the density of development and amount of water usage. This is particularly a threat when islands convert from low water use systems such as hand pumps to pressurized water systems that make it possible for households to pump much higher amounts.

In the Town of Harpswell, a complex of narrow islands and peninsulas, for example, many wells located in intensively developed shorefront areas have been contaminated with salt water. The accompanying map shows the locations where this has occurred.

Assessing which areas are vulnerable to saltwater intrusion is complicated by rising sea level. Scientists estimate that sea level in Maine may rise as much as three feet during the next 100 years because of climatic change. This means that the brackish boundary between saltwater and the freshwater underlying the shoreland area will migrate landward, especially in flatter areas, as the sea rises.

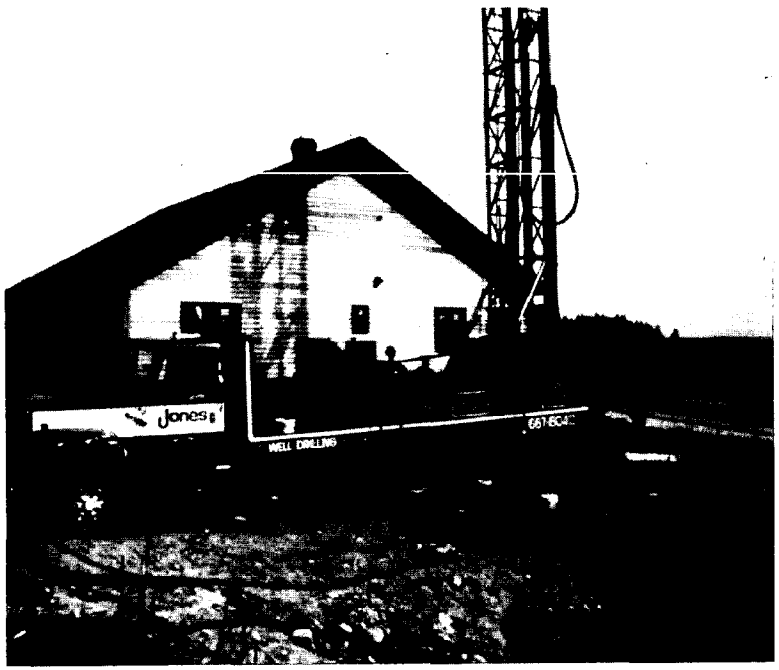


Limits: If wells are located away from the zone of influence of saltwater at densities less than one unit per acre, and the amount of water withdrawn from them does not exceed the amount recharged even in drought years, saltwater intrusion should not be a problem. This is not to say that development in the interior of islands is immune from saltwater intrusion. In places where more than 250 gallons a day per acre are withdrawn, saltwater intrusion could occur considerably toward the interior, especially during dry periods and where fracture zones are most favorable.

To avoid the interface between the freshwater lens and the sea, and to anticipate sea level rise, new wells should be located at least 200 feet above the high water mark in undeveloped areas and set back 400 feet in places where development is already concentrated. These setbacks can be used as minimum guidelines island-wide, but an on-site investigation for each new well is needed because of the high variability of hydrogeologic conditions.

Finding potable water without risk of saltwater intrusion can be difficult on smaller islands. The rule of thumb for islands smaller than 5 acres is that they usually cannot support a reliable year-round water supply.

Contamination from subsurface wastewater disposal. New subsurface wastewater disposal systems are not usually a threat to the environment, providing they are installed properly using the latest technology. However, many older sewage disposal systems in use on the islands pose a risk to the quality of ground and surface waters. An island's carrying capacity can be increased and threats to water quality decreased by upgrading inadequate systems.



Wells drilled close to the ocean shore are vulnerable to saltwater intrusion.

Fifty years ago, a household used about 5 gallons of water a day. Outhouses were the norm and people generated very little "gray water", i.e. the effluent from sinks, bathtubs, washing machines, and dishwashers. Pressurized pumps and drilled wells now make 250 gallons a day of water use possible. Cesspools and septic systems may not have been

upgraded over the years to handle the increasing volume of wastewater. Until 20 years ago or more, septic systems could be installed within the seasonal high water table. Effluent from undersized systems and systems installed within the water table or on thin soils is likely to break out at the surface over time, posing a risk to human health and water quality.

Homeowners are not usually required to upgrade old septic systems when expanding or converting homes to year-round use, although the changes increase the likelihood that the system will malfunction.

Systems can be difficult and expensive to replace, especially on older subdivided lots which offer little or no alternative space for a retrofit. Because of the high cost of hauling fill from the mainland to upgrade a leach field, many islanders look the other way when their system fails.

Non-conforming lots are getting more attention:

The "Colony" near Dark Harbor on Islesboro is a good example of the difficulty of managing septic wastes on non-conforming island lots. Subdivided into postage stamp-sized lots around the turn of the century, as were many shoreland areas in Maine, the settlement provided housing for people who worked for the "summer people." Wastewater disposal on lots as small as 99 x 130 sq. ft. was not a problem when outhouses and hand pumps were used. Greatly increased water use, however, has resulted in some contaminated wells

The town is now conducting a survey of the condition of septic systems in the area in anticipation of applying to the Department of Environmental Protection for a Small Community grant to build clustered treatment systems. Even such group systems managed by landowner associations are not free from possible failure, however. Their successful maintenance and repair requires cooperation among landowners, as well as the introduction of low-flow plumbing fixtures and other water conservation measures.

See Appendix 1 for a copy of the sanitary survey Islesboro has asked all home and business owners to complete.

source: Rick Rogers, Islesboro Code Enforcement Officer

Sewage treatment alternatives breath new life into existing development:

An innovative sewage treatment system has allowed Orcas Island, one of Washington's San Juan Islands, to clean up a nagging contamination problem that stifled the vitality of the commercial area near the ferry landing. The tightly knit area of residences and businesses has a year-round population of about 100. Daytrippers increase the number of people "downtown" two to three times in the summer.

The new system replaced cesspools, direct discharges, holding tanks and other non-conforming subsurface waste disposal systems that were contaminating Puget Sound and threatening public health. Each "user" now has a 1000-gallon concrete septic system, fitted with a screen and pump. The screened effluent, about 90% of the original input, is pumped from the individual tanks into a common sand filter. The sand filter removes over 95% of the biological oxygen demand and total suspended solids. What comes out at the other end is chlorinated, then discharged into the Sound.

The screen is an innovation that leaves 90% of the solids and little liquid in the holding tank, rather than a large amount of "blackwater." This means that the tanks need only be pumped every 10 to 15 years, compared to the conventional unscreened system primarily used in Maine which needs to be pumped every two to four years.

The pumps fitted to each tank move the effluent through the system at a regular rate and amount of flow, with periods of inactivity in between. This means that the common sand filter can "have some time off" between doses to rejuvenate its air and bacterial content for greater efficiency. The individual pumps also beat the problem of gravity by avoiding the need for large pumps that move flows up-gradient in conventional systems.

Diamond Lake, Washington, also used individual pumps to overcome gravity. Its "step-collection system" starts with individual screened vaults that feed into mains that are relatively small in diameter (1.5-4") and sized larger as the effluent gets closer to the communal treatment facility. The collection system feeds into an aerated lagoon system that discharges eventually into the lake.

The cost of a step and sand filter in Elkten, Oregon, was $7,000 per household compared with about $28,000 per household, the cost of a conventional system in a community of similar size.

Source: William Perkins, Applied Wastewater Technology, Boxford, MA.

Many islanders rely on overboard discharge systems, which treat sewage effluent by passing it through a sand filter system, chlorinating it, and discharging it into the ocean. These systems were originally permitted to allow development on marginal soils, where installation of a septic system and leach field was problematic.

However, overboard discharge systems can introduce toxic chlorine into the marine environment or cause bacterial contamination of shellfish. These systems may not be an environmental threat when they work, but the Department of Environmental Protection estimates that as many as 50% do not function properly. The state has established a program to remove overboard discharges where feasible, usually by converting to in-ground disposal systems. In recent years, technological advancements have made the construction of subsurface disposal systems possible in places that had previously been unsuitable, however the risk of contaminating groundwater is still a concern.

On some islands, where an alternative sewage treatment method would be prohibitively expensive and technologically challenging and no commercially valuable shellfishing areas will be affected, such as Monhegan, the state allows the continued use of overboard discharge systems.

Monitoring and improving sewage treatment can minimize the risk of groundwater contamination from sewage effluent. However, there may still be concern that nitrate-nitrogen, pathogenic bacteria, and household chemicals in effluent could contaminate wells. It is generally believed that subsurface disposal systems that meet Maine's current Plumbing Code provide adequate treatment of pathogenic bacteria. Minimizing the risk of contamination from household chemicals is best accomplished by their proper disposal, which means not pouring them down the drain.

The Plumbing Code is believed by many professionals to be unreliable in protecting against nitrate-nitrogen contamination, especially where development is concentrated on small lots (< one acre) with thin soils, i.e. less than three feet to bedrock. Drinking water standards deem a safe concentration of nitrate-nitrogen to be not more than ten milligrams per liter. In excessive amounts, which fortunately are not common, the contaminant is dangerous to young children. It can cause a deadly condition known as methemoglobinemia, or "blue-baby syndrome". It may also be linked to the occurrence of stomach cancer in the general population.

> **Limits:** To account for the inability of thin and marine clay soils to adequately dilute nitrate-nitrogen, a maximum density island-wide of 1.5-3 acres per unit can be used as a rule of thumb for islands that rely upon on-site wells and septic systems. Relatively flat islands that contain relatively good soils (deep sandy or silty till, or sand and gravel) can use the 1.5 acre per unit factor in calculating an estimate of carrying capacity; those where the soils are predominantly shallow or clay should use a factor of three acres per unit or greater.
>
> This "rule of thumb" can be used to estimate the total number of residential units that can be built on an island without exceeding nitrate-nitrogen limits. On Vinalhaven, where Robert G. Gerber, Inc. completed an in-depth evaluation of existing data, the firm

Good site planning is essential in Maine's complex glaciated terrain:

The rules of thumb recommended for groundwater in this handbook are intended to provide guidance in planning overall development densities for an island or portions of an island. Because hydrologic and geologic factors can vary greatly within short distances due to glacial effects and fracture patterns in the bedrock, there should be more detailed study of each particular site to establishing lot size and septic system setbacks from wells and property lines. Designing a site to fit its natural capacity will help ensure an adequate amount of groundwater recharge and avoid septic contamination of wells.

The following table can help homeowners and land planners determine the appropriate lot size for any given site based upon its soil characteristics. Where the direction of groundwater flow is relatively obvious (sloping sites) and assuming drought conditions, separations and approximate sizes should be as follows:

Thin Sandy Till (<3')

Well to property line:	100 feet minimum
System to property line:	250 feet minimum
Individual lot size:	1.7 acres
Cluster density:	0.6 units/acre

Thick Silty Till (>3')

Well to property line:	100 feet minimum
System to property line:	350 feet minimum
Individual lot size:	2.5 acres
Cluster density:	0.4 units/acre

Marine Clay/Thin, Silty Till

Well to property line:	100 feet minimum
System to property line:	400 feet based on dilution
Individual lot size:	5 acres
Cluster density:	0.2 units/acre

Sand and Gravel

Well to property line:	100 feet minimum
System to property line:	200 feet minimum, 250 feet where systems in the same development are down gradient
Individual lot size:	.5 acres, depending on slope
Cluster density:	1.2 units/acre

For areas with slopes of 5% or less, the direction of groundwater flow is difficult to determine, and well-septic separation should be calculated conservatively as if the well is downhill from the system. Cluster densities are approximate and require site specific evaluation for verification of the protection of groundwater quality and public health. Source: Robert G. Gerber, Inc.

recommended a 2-acre maximum density in most parts of the island.

Alternatively, the carrying capacity for nitrate-nitrogen can be increased by using peat-lined leachfields, which halve the amount of nitrate-nitrogen entering the groundwater.

Other contaminants. Petroleum, salt, and other chemical products are also threats to Maine's groundwater. Most contamination problems, such as household chemicals poured down a toilet, could be avoided through better education and heightened sense of personal and corporate responsibility for the environment. Some of these contaminants pose significant health risks and their discharge into the environment is illegal.

Inventorying Groundwater

To assure the availability of adequate, high quality drinking water supplies over the long term, islanders need a clear understanding of their island's groundwater resource. Such a study should address the following:

1. The characteristics of bedrock geology, especially the locations of fractures and topographic lineaments that indicate recharge areas and migration patterns of groundwater resources;
2. The physical and hydraulic characteristics of surficial geologic deposits and the thickness of the soil on the island, particularly those areas most important for ensuring recharge;
3. The location, type, depth, yield, water levels, and quality of existing wells on the island;
4. The relationship of the fresh groundwater supply to its interface with saltwater;
5. The geology, safe yield, and water quality of any groundwater aquifers suitable for existing or potential community water supply;
6. Any existing or potential land use patterns, practices, or contamination sites that threaten the quality and quantity of the island's groundwater supply, and in particular, the number of households/businesses and amount of water use that can be supported on the island without degrading water quality or exceeding groundwater recharge; and
7. Recommendations for protecting the quality and quantity of the resource.

A less extensive and expensive assessment of groundwater resources can be compiled from a review of existing data such as published maps, well drilling logs, water quality test data, and borings from development permit applications or public works projects. Such a "first-cut" in-office groundwater analysis can generally be contracted for less than $10,000, depending upon the size, location, and complexity of the setting and issues to be studied. Those communities preferring a citizens' approach, should consult "The Planning Process for Local Groundwater Protection" available from the Department of Environmental Protection.

Developing a Local Strategy to Manage Groundwater

Considerable information is available from state and federal agencies on how to manage groundwater. The following discussion highlights some suggestions that are especially pertinent to islands:

Establish an island-wide maximum density for development. Many communities make the mistake of believing that full development will never occur, so they don't plan for it. But it can and may, so islanders should be sure that the development pattern allowed by local regulations is the one they want to end up with. (See the "buildout" discussions on page 65 and in Appendix 3.)

Islanders need to assess whether full development of their island or a portion of it will exceed its overall carrying capacity. In the case of groundwater, how much of the island's water supply and contaminant absorption capacity can each individual lot or development use up as its fair share? The development density a community or landowner group uses as a guide for groundwater carrying capacity needs to be based upon several factors.

The bottom line is that overall maximum densities should not be greater than one acre per unit—at a minimum — to maintain quantity and avoid saltwater intrusion on islands over 100 acres in size without narrow peninsulas. On peninsulas, islands between five and 100 acres, or where water supply is limited, overall densities should not be greater than 2.5 acres per unit. On islands less than five acres in size the chance of finding potable water is low and the likelihood of saltwater intrusion is great; low impact uses such as recreation may be all that is advisable.

To guard against nitrate-nitrogen contamination, densities should be even lower than calculated on the basis of water quantity alone. On islands with extensive flat areas with thick soils, densities should be no greater than 1.5 acres per unit. On all others, they should be no greater than three acres per unit.

These generalized numbers are useful for assessing an island's carrying capacity, but they do not substitute for site-specific hydrologic studies, which can be required as part of local review of certain development proposals.

Many communities rely upon the Plumbing Code as a de facto means of managing growth. The code may not be effective in establishing development densities that ensure clean surface and ground waters. It addresses only contamination from septic systems and does not ensure adequate groundwater quantity or protect against contamination from stormwater runoff and saltwater intrusion.

Code changes proposed in 1994 may make considerable amounts of land developable that had not previously met the standards of the code. In the absence of strict local zoning, the new regulations could result in development patterns that change an island's special character. Recognizing the narrow focus of the Plumbing Code, it is all the more important to address the multiple facets of carrying capacity locally.

Site wells and wastewater treatment systems in the most advantageous parts of an island. Because the reliability of both wells and septic systems is so tenuous on coastal islands, it best to site them in the most favorable locations.

Ideally, individual wells or a community well should be sited in the interior portions of an island to avoid salt-water intrusion. However, new water quality monitoring requirements for community water supplies could put the cost of regulatory compliance out of reach for homeowner associations interested in sharing common wells. Community water supplies are defined by Maine's Drinking Water Program as those serving 25 persons and/or more than 15 service connections.

Alternatively an innovative or conventional communal wastewater treatment facility could be installed to concentrate wastewater treatment in the location where it will do the least harm.

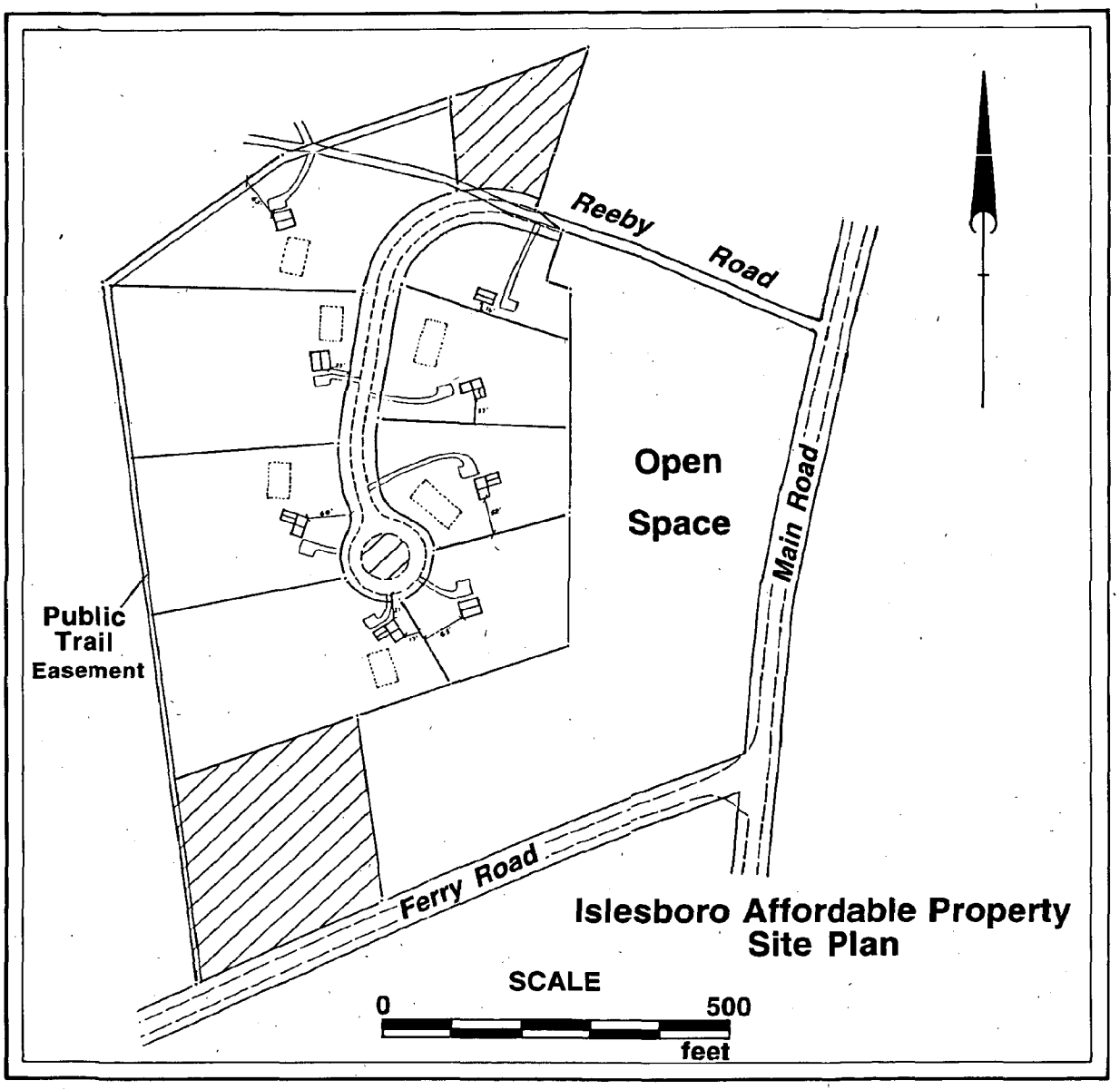
Consider using alternative sewage treatment technology or innovative regulatory schemes. New technology such as sand filter systems, peat bogs, and wetland systems are being used with success around the United States. Because of limiting soil and bedrock conditions, the Chewonki Foundation in Wiscasset recently installed man-made cattail marshes to treat its sewage instead of a traditional leach field. Usually, alternative treatment systems minimize the reliance on soils to perform the treatment function.

Innovative designs and conservative standards can help:

Islesboro Affordable Properties has sited 8 lots on less than half of a 14-acre property. Even though the soils are good, project planners used design criteria more stringent than the Plumbing Code, such as increased separation distance between the bottom of the disposal field and the seasonal high water table, to increase their confidence that the septic systems will not fail over the long term. The lots average around 20,000 sq. ft., considerably less than the town's minimum size of 1.5 acres for conventional lots. This leaves more than 50% of the land in common open space.

Another approach would be for a community or landowners association to create a "sanitary district," as Eagle Lake, Maine, has, with the authority to own and maintain holding tanks that are required for all development instead of leach fields. The quasi-municipal district would be responsible for periodically having the holding tanks pumped and maintained. While this approach applied to an island requires a car ferry to transport the septage collection trucks, it offers the advantage of minimizing the risk of contaminating an island's only source of water supply and making the transport of septage more cost effective.

Innovative technology such as "advanced biological systems" and administrative arrangements such as Eagle Lake's sanitary districts can also enable communities to site new development in areas of existing settlements. Villages are often the most sensible locations for development for social, fiscal, aesthetic, and environmental reasons, if the sewage treatment and water supply challenges can be successfully resolved.


Reeby Road
Main Road
Ferry Road
Open Space
Public Trail Easement
Islesboro Affordable Property Site Plan
SCALE
0
500
feet

Other suggestions. Several other techniques for protecting groundwater mentioned in the discussion of limits are listed below:

Limit impervious surface to no more than 25% of an island;

Require a setback of at least 200 feet between septic systems and down-gradient property lines to avoid the risk of contaminating wells;

Conduct a sanitary survey of septic systems in villages or other densely settled or problem areas and develop a management strategy to upgrade non-conforming and/or malfunctioning septic systems or provide an alternative approach to treating wastewater; (See Appendix 1)

Install water saving devices and other conservation measures;

Adopt local standards more stringent than Maine's Plumbing Code, requiring landowners to certify, if possible, or to upgrade if necessary, their non-conforming septic systems to meet current standards before permits are granted for expansions or conversions; (See Appendix 1)

Use composting toilets, destroilets, privies, or alternatives to conventional toilets as another way to conserve water;

Require setbacks from the shore for wells and limit the amount of withdrawal on a per acre basis to 250 gallons per day; and

Monitor water quality and water levels. Water levels can be obtained from drilling records from local well drillers or the Maine Geological Survey and recorded in a methodical way in the Town Office. Communities may want to require well drillers to file this information locally.

Lincolnville puts the lid on non-conforming septic systems:

The Lincolnville Board of Selectmen has adopted an administrative policy requiring that no plumbing fixture be added to a structure built earlier than 1980 without documentation that the septic system is designed to accommodate the change. If the owner cannot document the design of the system, the plumbing inspector will conduct a dye test to verify its capacity. Rick Rogers, Code Enforcement Officer/ Plumbing Inspector for Islesboro and Lincolnville, recommends that every town enact requirements more stringent than the State Plumbing Code to protect against system failures. For more information on the Lincolnville policy, see Appendix 1.


RECYCLING CENTER
1 & 3-PLASTIC
2-PLASTIC

SOLID WASTE

Limits and Threats

In contrast to the concept of carrying capacity as the upper limit of growth, solid waste requires a minimum population base on an island for effective management on a community basis.

A minimum trash generation rate is necessary to offset the high costs of managing solid waste. The less a community produces, the more difficult it is to establish cost-effective recycling and transportation to one of the state's regional transfer or disposal facilities. Ironically, the lower the population and the less trash generated, the higher the per unit costs are to manage the trash that is generated.

Average Waste Generation Rates (tons per person per year):

Population	Non-Bulky	Bulky	Total
< 1,000	0.35	0.11	0.46
1,000 to 2,000	0.49	0.15	0.64
2,000 to 5,000	0.55	0.17	0.72
5,000 to 10,000	0.75	0.23	0.98
> 10,000	0.77	0.23	1.00

source: Maine Waste Management Agency.
Average generation rates for Maine municipalities, includes commercial generation, so rates will vary with types of business and levels of activity.

Unless an island has its own landfill — and the days of such landfills are numbered — it will pay more per ton for waste management than mainland communities. An Island Institute study in 1991 reported the 1990 municipal cost per ton for managing waste on eight islands with municipal programs ranged from $19 to $424. In comparison, most mainland communities without landfills spend between $75 and $250 a ton for disposal, and $50 to $120 a ton for recycling, according to the Maine Waste Management Agency.

Island Solid Waste Management Costs (per ton):

Isle au Haut	0	Chebeague	$66
Matinicus	0	Frenchboro	$83
Vinalhaven	$19	Islesboro	$108
Swan's Island	$34	Cranberries	$358
North Haven	$65	Monhegan	$424

source: Island Institute, 1991

Isle au Haut and Matinicus have had no municipal waste management program. The responsibility is left to individuals who burn, bury, reuse, recycle, or remove the trash from the island. The next six communities in the table have landfills that will be closing because of state and federal

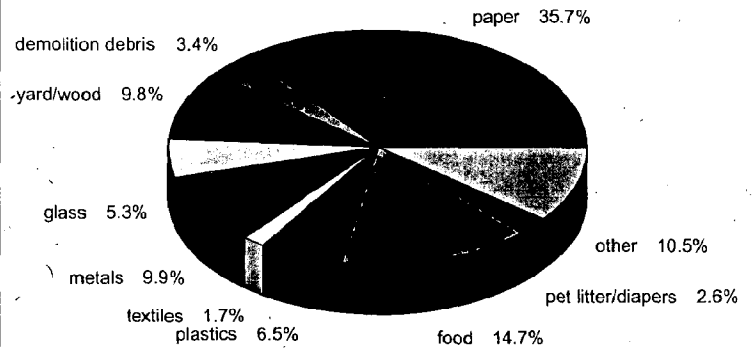
regulations. The Cranberries and Monhegan transport material for recycling and disposal to the mainland. Vinalhaven, Matinicus, and Islesboro are working with Camden-Rockport Transfer Station to handle portions of their waste.

Solid waste management is difficult on islands for three reasons. They have unique physical characteristics, small and fluctuating population bases, and they are isolated. With inadequate soil cover and vulnerable groundwater supplies, islands are especially poor places for landfills. As discussed in the groundwater section, all Maine islands are sole source aquifers from which most islanders derive their potable water. Accordingly, even development of a "fail-safe" landfill would present unique risks and high costs to island residents.

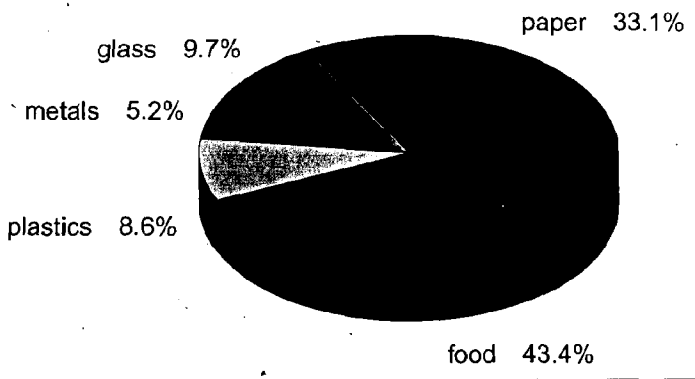
Population also works against waste management on islands — on two counts. First, year-round island populations are relatively low, precluding cost efficiencies that mainland communities of greater size can achieve. Second, island populations fluctuate dramatically by season. Island communities need a flexible contractual arrangement with a hauler and a disposal facility that takes into account seasonal changes in the amount of waste generated.

The high cost of disposing of small amounts of trash cannot be offset easily by joining with neighboring communities. Water gets in the way. Transportation by boat raises the overall cost of disposal. Costs related to disposal often exceed the cost to bring an item to an island in the first place. For example, the removal cost of a dilapidated car may exceed the cost of bringing the car on the island.

Municipal Solid Waste in Maine
Overall Composition, 1991
(percent by weight)



Municipal Solid Waste on Monhegan
Overall Composition, 1988
(percent by weight)



Inventorying the Waste Stream

Before an effective solid waste management strategy can be developed for an island, an assessment needs to be made of how much trash is generated, and what is its composition. To find out, a community can conduct an "audit" of its waste stream.

Maine law defines municipal solid waste as solid waste generated by homes and normal commercial operations. Paper is the largest component (slightly greater than a third) and food wastes the second largest component (almost 15 %) of Maine's municipal waste.

Island communities may vary significantly from the state-wide profile, depending upon the presence or absence of restaurants, hotels, industries, and other businesses. Monhegan, for instance, found through its local trash audit that almost one-half, rather than one-seventh, of the waste stream was composed of food wastes. Since food wastes were the single largest component, a home-based composting program became a high priority. Restaurant waste makes up the largest share of the island's food wastes, but since much of this waste is in liquid form and harder to compost, Monhegan's program has targeted home-based generators first.

Waste stream analysis, in addition to enabling informed decisions about management options, has another important benefit. It can raise public consciousness, get people involved in the issue, and ensure timely and positive response to local trash disposal initiatives. That was certainly Monhegan's experience.

Monhegan's SWAT Team (Solid Waste Attack Team) set up its waste tally system on the public dock during the month of August 1988 with the help of consultant Will Brinton. The garbage committee sent letters to all taxpayers on and off the island well in advance of the summer season. The letters explained about the audit and how to participate. Residents, hotels, restaurants, and other businesses were asked to separate their garbage into several categories and package each

Monhegan Garbage Separation Tally Sheet

DATE:_____

Material	**Weight (*in pounds*)**	**Day's Total**
*** Tare**		
Glass		
Plastics		
Metals		
Moist Food Waste		
Wet Food Waste		
Paper		
Newspaper		
Cardboard		

container weight which is deducted from total weight

category in a clear plastic bag. The town dock was open for collection between 5 and 6 p.m. each evening when the trash was counted and weighed on freight scales. When the audit was complete, support was high for going ahead with a targeted strategy for managing Monhegan's waste.

The audit on Monhegan is just one example of how an audit can be conducted. An audit should be as simple as possible, but should document:

1. The types and amounts of waste generated,
2. How trash is normally collected and disposed of on the island,
3. How many people and local businesses generate the waste, and
4. The types of management options the community may wish to consider.

The way an audit is conducted can vary. Tally sheets can be developed for different types of audits such as households or marine industries. Waste categories can be specific or general. If, for example, a community wishes to explore crushing glass for reuse on the island rather than shipping it off, it would need to know how much glass overall is generated in order to determine what size glass crusher to purchase.

Managing Solid Waste

When Maine's landfill-related environmental problems became evident, the state sought a way to minimize the environmental and financial costs of waste disposal alternatives. The answer was a statewide policy making disposal the option of last resort.

The **top priorities** of the strategy are **reducing** both the volume and toxicity of municipal solid waste and **reusing** products and materials. Since 1988, the state has reduced municipal solid waste generation by almost 10%. **Recycling is next in priority** and already the state-wide recycling effort has doubled. To increase the amount recycled, towns are now focusing attention on **composting.** All of these efforts are aimed at reducing the amount of waste requiring **disposal, the last resort in the strategy**. The Maine Waste Management Agency is also now placing emphasis on ways to manage construction and demolition debris, market recyclables, and reduce waste management costs.

How do islands fit into the state's strategy? Progress has been slow because of the special characteristics of islands. Traditional means of managing solid waste on islands have included open burning, burial at sea, and landfilling. In many cases, residents and visitors have also carried their wastes off-island to mainland communities. Historically, the disposal of white goods, junk cars, construction debris, and chemicals such as waste oil have been left to individual responsibility.

One by one, all of these options, except removal to the mainland, are being discouraged or eliminated for environ-

mental reasons. Faced with a tough federal requirement for groundwater monitoring and clean-up and a state law phasing out unlicensed landfills, the island communities of Frenchboro, Swans Island, Islesboro, North Haven, Vinalhaven, and Chebeague Island must look for alternative means of dealing with their formerly landfilled wastes.

Most of these communities have arranged for private contractors to haul waste to the mainland on existing runs of the ferries.

Isle au Haut and Matinicus must now also develop their own municipal programs. Monhegan is in compliance having conducted a waste audit and put in place its program for composting food wastes; crushing glass; collecting batteries, paint solvents, and white goods; and compacting the rest for mainland disposal.

On islands without a year-round community, waste management practices vary. Mainland communities and the Land Use Regulation Commission, depending upon which entity has jurisdiction over an island, should require a solid waste disposal plan to be part of any island development proposal they review. Currently individual applicants for Land Use Regulation Commission permits make their own ad hoc arrangements with whichever community they wish.

The management strategies that hold most promise for Maine's islands are discussed below. Brochures can also be obtained from government agencies explaining how to develop some of these options. Since no single management option will serve as a cure-all for any town's waste problems, islanders should consider adopting a mix of options.

Managing solid waste at an island home: a burn barrel and grain bag of trash waiting for monthly pickup. Although it's not usually a formal local policy, one way islanders reduce the amount of trash that needs to be hauled off-island is to burn what they can.

Reuse and reduction. Since the cost of transporting waste to the mainland is so high, the best policy is to keep solid waste levels as low as possible. This means using products and materials longer, reusing them for new purposes, and reducing the amount used in the first place. These strategies fit well with the self reliance of islanders many of whose families have been practicing them for generations.

One of the ways that everyone, especially large volume food handlers such as hotels and restaurants, can contribute to waste reduction on islands is to purchase items that have less packaging, condensed concentrations, or refillable

containers. Some products, such as small appliances, have been redesigned to facilitate their recycling.

A possible incentive for reducing trash generation is to use "pay-by-the-bag" pricing to cover part of the cost of disposal. Under unit pricing, households and businesses are charged for disposal services based upon the amount of trash they generate. For instance, Monhegan charges $2 a bag for trash disposal. If consumers know they must pay more to produce more garbage, they will take advantage of source reduction and recycling opportunities to reduce their trash—and their trash disposal bills. Case studies show that pay-by-the-bag programs reduce conventional waste collection most effectively when used in conjunction with recycling and composting programs.

Recycling. The money that can be saved on landfill and incinerator fees is an incentive for recycling. On the mainland, recycling usually costs less than disposal. While no data exists for island communities yet, the savings are probably not as great because islanders pay high transportation costs for both recyclables and trash. Remember the figures mentioned earlier: mainland communities typically spend $50 to $120 to recycle a ton of waste, while they spend on average $75 to $250 per ton for collection and disposal.

Several island communities are already involved in recycling. The Camden-Rockport Transfer Station is working cooperatively with Vinalhaven, North Haven, Islesboro, Monhegan, and Matinicus to collect portions of their waste stream. Vinalhaven has initiated a voluntary recycling program. North Haven recycles crushed glass, aluminum and tin, and involves students in educating townspeople about the benefits of the program. The Cranberries also recycle these materials, as well as newspapers.

Composting. Composting is a form of recycling, and an effective way to reduce the volume of waste that needs to be hauled off-island. Yard wastes, such as fallen leaves, grass clippings, weeds, and the remains of garden plants make excellent compost. Kitchen wastes free of meat, bones, and fatty foods can also be composted. These materials are placed in an outdoor container where they are turned periodically to facilitate the natural decay process brought about by microbes, fungi, and other organisms under the right conditions. The resulting product—compost—can be used to enrich the soil for growing gardens, trees, and shrubs, a welcome supplement to the thin soils commonly found on islands. Woody yard wastes can be shredded and used as a mulch for gardens and a surface for paths. It, too, will eventually decompose.

Monhegan has a backyard composting program for island households. The town bought composting units with a grant, as an incentive to get people involved.

The University of Maine Cooperative Extension Service offers a good handbook and video on composting available for people who are interested. The Knox-Lincoln County Cooperative Extension at 594-2104 can provide details.

Disposal. No benefit is derived from materials that must be disposed of, unless energy is made in the process of incineration. Disposal is a financial sink hole, made even deeper by the high transportation costs and low volume

generation of island populations. With the closing of the landfills and the ban on burning and ocean dumping, islands are moving toward hauling material for disposal off-island to an incinerator or licensed landfill.

The only disposal options are to contract with an off-island landfill or incinerator for waste disposal, perhaps by joining a compact of mainland communities or hiring a private firm to come to the island, haul the material off, and dispose of it properly. Monhegan belongs to the Camden-Rockport Transfer Station which hauls disposable wastes to a regional incinerator. Vinalhaven recently contracted with a private hauler for the same service.

Vinalhaven, Monhegan, the Cranberries, and the Portland islands set aside a day or two a year for collection of white goods and harmful wastes. Junk cars are a particular problem. One of the most innovative ways to deal with them, in addition to the excise fee the state now charges, is charging a fee for each car brought onto an island to cover the eventual cost of removal.

Some suggestions from the Maine Waste Management Agency for managing waste on islands include the following:

1. Conduct a waste stream assessment to pinpoint waste management needs;
2. Look at both the short- and long-term trends for jobs and population on the island to project waste stream growth;
3. Use a public education and involvement program to establish two-way communication between waste managers and the people they serve. Tailor the program to the island's needs and keep up public outreach over the long term to maintain active support and participation.
4. When planning a local management system, consider both the public and private collection approaches. Collection programs are often the most costly component of the system and need to be designed with care.
5. Consider obtaining priority reservations for haulers' use of public ferry service to and from the mainland;
6. Maximize the load volume per trip. Consider using a trash compactor on island to make the most of storage capacity at the collection point (odor and leachate nuisance need to be prevented or kept to a minimum);
7. Use a default factor of $1.00/ton/mile for transportation costs on the mainland as a general rule of thumb in addition to the boat/ferry costs;
8. On privately owned islands, "carry in, carry out" is the best policy; make arrangements for mainland disposal; and
9. Minimize the frequency of collection—to the extent that aesthetic and health factors, household/business storage capacity, and seasonal, climatic, and demographic variations allow.

SOCIAL EXPERIENCE

Trying to figure out how many tourists are enough on an island is like boiling a frog in cold water. If you put the frog into hot water, it'll jump out immediately. If you place it in cold water and start raising the heat, the frog won't realize what's happening until it's too late. It's equally difficult for us islanders to detect how the gradual increase in the number of daytrippers is affecting our psyche.

Maine island resident

Limits and Threats

Islanders and visitors value islands for many of the same reasons, but they sometimes have conflicting expectations, even among themselves, about the kind of experience they want to have while on an island.

Daytrippers and other visitors go out to the islands to walk, exercise, camp, bike, boat, pursue art, observe nature, enjoy the scenery, or explore a village or landscape reminiscent of an earlier time. Many seek solitude. Most usually go with the expectation of a special experience.

People live on an island year-round or seasonally for many of the same reasons people visit. Some residents value the sense of interdependency among neighbors necessitated by island living. Others, especially those who summer on smaller islands, like their islands for the opposite reason—seclusion and independence. Some families have been rooted on their island for generations. Many make a living from the sea.

For residents and short-term visitors alike, the quality of an island experience depends in great measure upon the number of people one encounters in relation to the kind of experience one expects. Those seeking privacy don't want to share island space with a lot of other people. Those expecting a quiet, close-knit community that makes its living from the sea are put off by a large number of tourists and strangers wandering around. Residents who make a living from tourists may welcome the swelling numbers. Other residents believe too many tourists hurt their businesses, especially if they cater to those looking for a quiet retreat from the faster-paced mainland.

In recent years, at least, numbers of visitors and how or whether to limit or direct them has been an issue with some island residents and landowners. For example, the number of daytrippers on Monhegan, bikers on Islesboro, hikers on Isle au Haut, and boaters visiting popular undeveloped islands have been a concern.

How can everyone's expectations be met? The simple answer is, they can't. But islanders, as landowners or communities, can identify the kinds of experience they want and visitors to their island seek, and weave that knowledge into the larger discussion of an island's ecological, environmental,

physical, and fiscal limits, and economic viability. A community can use its understanding of how people feel about the social fabric of the island in making decisions about factors that influence the numbers of people drawn to it, for example, the type of economic activity it promotes or the capacity of the utilities it develops.

Some islanders wonder what kind of limits can be imposed legally to limit island visitors. University of Maine School of Law professor Orlando DeLogu says that if the social experience of a particular island or group of islands is a special part of Maine's heritage, then social carrying capacity can play an important role in establishing limits to growth. However, case law directs communitites not to limit residents or daytrippers based simply on the reason that they "like a small population." Such limits would have to be supported by conclusive technical data, such as information documenting that tourists have an adverse effect on an island's traditional fishing economy, for example.

Damariscove Island off Boothbay Harbor is a popular destination for recreational boaters.

Monhegan daytrippers see themselves in many ways

A 1993 survey of 670 daytrippers conducted by Monhegan Associates found that many label themselves as sightseers (68%) and/or hikers (57%). Twenty percent (20%) called themselves naturalists; 17% photographers; 14% seekers of solitude; and 10% artists.

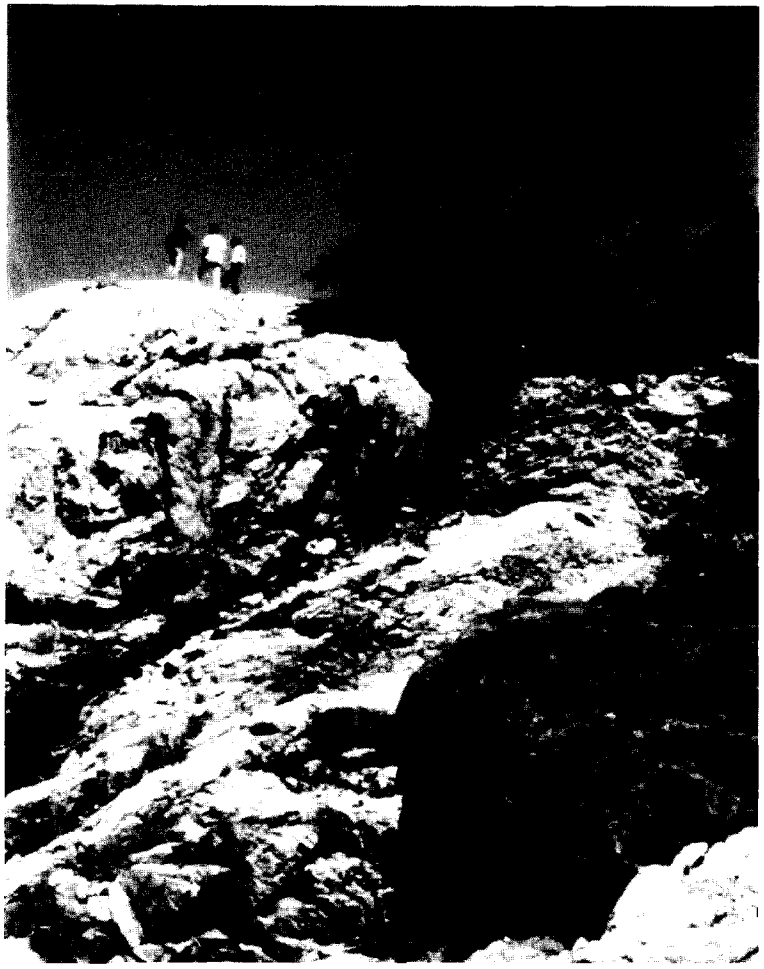
Almost 70% visited island shops and restaurants. Just under half visited the community's museum. Around 40% visited art studios or the art gallery. About one in four opted for a cold swim in the ocean.

The survey enabled respondents to select more than one choice for how they see themselves and what they did while they were on the island. A paid surveyor interviewed willing parties of daytrippers departing on the return trips to the mainland on 17 afternoons during the summer of 1993.

Monhegan residents generally agree about why they live or summer on the island

Most residents say they live there because of the general quality/way of life and natural beauty/clean environment, according to a 1989 survey conducted for the Monhegan Advisory Committee. Other reasons cited, in decreasing order of importance, include: island people, privacy, family, "other", and work opportunity.

Isle au Haut, an exceptional case because much of the island is part of Acadia National Park, provides an example of how to manage for a quality experience on a remote and undeveloped island.



Hikers enjoy views from one of Isle au Haut's spectacular "stopping places."

Limits: In a carrying capacity study for Acadia National Park, the Appalachian Mountain Club recommended that people who arrive on Isle au Haut by park boat at Duck Harbor be limited to 90 daytrippers and 30 campers a day. The total number, (120), was derived by multiplying the average party size, (3), times the number of "stopping places" in the southwest corner of the island, (40), where use is heaviest. This limit is based on the finding that visitors and residents using the park want to occupy a private place.

According to the study, "When groups stop, for reasons such as picnicking, resting, sketching, or watching, they usually stop in a place where they can view the sea. Groups tend to look for a stopping place where they are out of earshot of other groups and can see only one or two other groups. Because this opportunity to occupy a private place seemed an important part of the Isle au Haut experience, and because these places are limited, the number of places that are available were counted . . ."

Visitors and islanders alike believe the park is already at the upper end of its carrying capacity, with respect to providing a quality experience for all users. And at least until now, residents believe the park is managing use in a way that effectively minimizes the number of visitors exploring the settled parts of the island.

The principle used for Isle au Haut—basing visitor limits on the number of stopping places—can be applied to

other islands with trails and camping sites. But the analysis, as did the one for Isle au Haut, should also consider the capacity of natural conditions to withstand use. For example, wildlife and vegetation may not be able to tolerate the amount of foot traffic that will result from the acceptable number of people using stopping places.

Inventorying Social Experience

What levels of use or development provide a satisfying experience? How many more people can be accommodated before the island feels crowded? The answers can be determined by surveying residents and/or visitors on a particular island, and observing their behavior.

An island community wanting to manage its experiential qualities needs to know the following:

a. The numbers of users and their activities;

b. How visitors access the island;

c. The impacts people have;

d. The acceptable levels of use related to experiential quality and the environment, as perceived by the owners, residents, or visitors themselves;

e. Who stands to gain or lose from curtailing numbers of visitors, seasonal residents or year round residents; and

f. The practicality of limiting use or discouraging visitors, managing impacts, and monitoring results.

Appendix 2 offers a method for surveying the number of daytrippers using an island. Such a survey can be expanded to ask questions about social experience. As mentioned above, Monhegan polled residents through a conventional public opinion survey and polled daytrippers on return trips to the mainland. Both residents and transient visitors were surveyed on Isle au Haut.

One of the limitations of the Monhegan survey (see next page) in providing guidance about the acceptability of the island's social experience is that it did not find out why people want the size of year-round/seasonal/daytripper populations to change. Knowing people's reasons would help the community choose appropriate management measures.

For instance, if a community knows the reasons year-round islanders feel comfortable with the present number of daytrippers (e.g. making an income) and seasonal residents want to curb the number of daytrippers (e.g. encroachment on their privacy), it can make some changes that will help minimize the impacts from tourism, such as using signs to direct daytrippers to the most appropriate areas.

1989 survey asks Monhegan residents how many people should be on the island

Monhegan contracted with Jim Haskell and Associates and its subcontractor O'Brien & Associates to find out, among other issues, how year-round and seasonal residents feel about the number of people on the island. Seventy-six residents responded to the 1989 survey; three out of four were seasonal.

Most respondents, year-round and seasonal alike, wanted the year-round population to increase. They favored a level of between 109 and 159 people, (up from the present population of around 90). On the issue of summer population they disagreed. Seasonal residents favored a slightly higher level, about 436 people compared with the less than 400 people selected by the year-round residents. They disagreed again upon the number of daytrippers. A majority of year-round residents would prefer the number to remain about the same, while two out of three seasonal residents would prefer to see it decrease.

Some key issues were not asked in the Monhegan survey that could help a community better determine the implications of such findings. Ways to focus such a survey are discussed on the following page.

Managing Social Experience

Developing a strategy to manage the number of visitors for social reasons is probably the most difficult of the carrying capacity issues to tackle. Setting limits outright for the number of daytrippers has political, economic, and legal implications. It is one thing to say that too many people will hurt the environment; and another to say that too many people will make an experience less satisfying.

Legally, limiting visitors on social grounds may be an abridgement of constitutional rights in the absence of clear, specific evidence that too many people will destroy the unique character or special heritage of a place. Policy makers and the courts have recognized the need to regulate experiential use in highly sensitive places, e.g. whitewater rafting quotas on Maine's Kennebec and Penobscot Rivers. While this principle has not yet been applied to coastal islands, it certainly could be considered.

In many cases, it will be more appropriate to use management techniques that lessen the impacts of daytrippers, and make policy decisions that discourage interest in an island, rather than limit access to visitors outright.

In response to the increase in recreational boating in recent years, and the accompanying increase in island visits, the Maine Island Trail Association attempts to direct small boat owners looking for a place to picnic, explore, or camp to islands where they are welcomed. The Association has permission for its members to use a string of public and privately owned islands. By creating a trail network, the

Exploring the reasons behind attitudes:

A community may already have a sense of why residents want to encourage or discourage more daytrippers or it may wish to ask questions such as the following in a survey. The questions and possible responses should be tailored to island conditions by a committee broadly representing the community and appointed to help prepare the survey.

1. If you are satisfied with the present number of daytrippers to the island, check one or more of the following reasons:

   Personal economic gain
   Vitality of island economy
   They don't do any harm
   They make life more interesting
   It is important to share island heritage with others
   They have a right to be here no matter what I think
   Other?

2. If you are dissatisfied with the present number of daytrippers to the island, check one or more of the following reasons:

   I prefer to see fewer people walk by my home
   They are noisy
   They contribute little to local economy
   They litter
   They come into my yard or onto my beach
   We don't have enough public toilets/water supply for them
   I feel like I don't know anyone I see anymore
   The island feels crowded
   Their questions bother me
   It's harder to get boat tickets when I want them
   It's harder to find parking on the mainland at the ferry
   Other?

privately owned islands. By creating a trail network, the Association hopes not only to direct boaters to islands whose owners have agreed to public access, but also to steer people away from the more vulnerable islands such as those with seabird nesting habitat.

In exchange for access to the islands, the Association promotes their wise use by its members. The Association's guide book not only lists the islands on the trail, but also promotes appropriate island behavior. The Association hopes that this educational approach will be effective in limiting environmental impacts on the islands.

In similar fashion, the Cranberry Isles mail boat and ferry schedule includes a map directing people to island attractions. Monhegan has a brochure and map recommending island etiquette and listing island businesses and services. Information about "acceptable behavior" and the location of public spaces and toilets is invaluable. People seem willing to do the right thing if they have the right information.

Some selected techniques for managing use are listed below:

a. Regulate mooring placement and use and docking space and tie-up times at town facilities;

b. Provide signs, maps, and other educational materials that steer visitors to appropriate places, highlight routes that spread people out, and minimize impacts on islanders;

c. Institute higher ferry fares for daytrippers than

d. Negotiate with commercial excursion and ferry boat owners and organized groups to develop schedules and head counts that contribute to quality experiences;

e. Ask organizations that carry people to an island, e.g. windjammers and commercial boats, to be aware of islanders' or landowners' management goals for an island;

f. Charge a fee to daytrippers to cover the costs of public toilets, solid waste disposal, beach/open space access, brochure printing, and others services needed to manage visitor use;

g. Regulate land use, e.g. limiting use of waterfront property to activities related to marine trades.

Residents and daytrippers waiting for the ferry to Chebeague Island.

San Juan Islands set goals to manage tourism:

The San Juan Islands, an archipelago of 172 islands in Washington State's Puget Sound region, are a major tourist destination. Marine tourism in the region has grown steadily due to increasing promotion and exposure in national and international media, coupled with rapid growth of nearby mainland population centers in Washington and British Columbia.

In response, San Juan County, the political jurisdiction that encompasses the islands, is developing a "Tourism Plan" to manage increasing use conflicts and minimize environmental and socio-economic impacts. The County's Tourism Planning Advisory Committee is spearheading the development of the plan and engaging the public in the process, with the help of The Madrona Group as consultants.

While the plan is in its early stages of development, some of the policies the committee is considering recommending include:

1. Tourists should pay, through taxes, fees, and other revenues principally targeted at tourists, for all of the direct and indirect costs of the public services or facilities attributable to tourism.
2. Carrying capacity of public facilities should be defined and calculated and used as criteria in tourism planning.
3. The county, the nonprofit sector, and/or the private sector should attempt to educate all tourists about the importance of caring for the island ecology and instill in them a respect for the islands and their residents.
4. Public policy should recognize that residents have a right to live in a stable, constructive community in which tourists are invited to participate in ways that do not damage the community.
5. Amenities provided by San Juan County should not act to attract more tourists to the area or attract the type of tourist who expects amenities as part of their travel experience.
6. San Juan County should develop only a) those public facilities which residents want for their own use and enjoyment, for which use by tourists would be incidental, and b) those public facilities which reduce tourist impacts.
7. In order to preserve the quality of life of county residents, the natural environment of the islands, and the prime resource for the tourism industry, protection of the islands natural beauty, wildlife, historic and cultural features, and the rural, small town atmosphere should be a high priority.
8. The county economy should be diversified by creating more year-round employment or seasonal industries that peak outside of the tourist season.

SOIL AND VEGETATION RESILIENCY

"Islands, like mountains, have shallow, fragile soils which are subject to erosion from compaction due to overuse. Also like alpine areas, their vegetation is under a variety of physiological stresses. In the case of islands, the stresses result from the effects of wind and salt, which combine to prune vegetation on the windward side of islands. Frequent storms and high winds cause significant blowdown, and, in some cases, airborn particles of salt are carried into island interiors where significant mortality to the vegetation can occur.

By virtue of their isolation, islands are also refuges for rare species of plants and animals." (Conkling and Leonard, 1984)

Limits and Threats

Heavy human use can impact an island's soil and vegetation beyond the point from which it can recover from year to year. Some of the state's most popular islands for recreational use, such as Jewell Island in Casco Bay and Hell's Half Acre off Stonington, show signs of stress from extensive use by people. The natural systems of other islands are likely to be degraded unless their limits are understood and use of the islands is carefully planned and monitored.

This discussion focuses on managing recreational use to minimize impacts on island soils and vegetation, however, these are not the only impacts of recreational use. Promoting proper disposal of human waste and trash, discouraging the destruction of trees for use as fire wood, and minimizing the opportunities for uncontrolled fires are some of the challenges of managing use on the heavily visited islands.

The quantitative "rules of thumb" contained in this section were gleaned from Dr. Raymond Leonard, former Director of the U.S. Forest Service's Backcountry Research Project. These suggested limits can be a very powerful tool for island managers — if applied at a point when island use is still low. Once heavy use occurs, impacts are more intense and longer-lived and people's behavior is harder to change. When badly abused, vegetation may take years to reestablish itself, or decades if the soil base is destroyed.

Limits. The amount of picnicking, camping, and hiking soil and vegetation can withstand depends upon a site's physical characteristics. A bog or steep slope can bear very little use. A flat grassy area tolerates much more abuse than a pine-needled forest floor. Most island sites can be used for backcountry recreation without showing visible effects if no more than 100 person visits per year occur. One expects persistent decline, however, if a site receives 500 person visits or more a year. When use reaches 1000 person visits a year, a site has to be actively managed to offset threats to soil and vegetation.

These rules of thumb must be tempered with knowledge of how many people use a site at any one time, how long they stay, what parts of the site they use, and the particular characteristics of the island. In general, 20 people using a site over a three-day period will probably not impact vegetation and soil in a persistent manner, especially if they limit use to the most resilient parts of the site. One hundred people using the same site for three days are likely to leave visible effects, as would ten people per day using the same site over a ten-day period. Most sites can tolerate parties of two visiting 25 times a year for two-day visits. More resilient ones can tolerate 50-100 visits under the same conditions. The Maine Island Trail Association recommends keeping group size small, six people or fewer on smaller or more popular islands, and keeping visits short, three days or less.

Based upon erosion and vegetation loss studies, the Appalachian Mountain Club found that trails on Isle au Haut could tolerate no more than 50 people a day without excessive wear. The Club also advised Monhegan Associates, stewards of 17 miles of island trails, that its trail system can withstand more use than it presently attracts, depending upon the specific condition of different trails. Based upon the results of a survey and an assumption that between 60 and 200 daytrippers visit the island on a summer day, between 34 and 114 hikers can be expected out on the trails. Most of the hikers visit the same places: Lobster Cove, White Head, and Burnt Head. Even the heavily used trails to these spots have greater capacity, with management, according to the Appalachian Mountain Club representative.

Inventorying Vegetation and Soil Impacts

To determine whether physical impacts to soil and vegetation are occurring, island managers may want to establish baseline and monitoring data. Studies of this type measure the amount of soil cover and types of species within study plots called transects. Soil loss and changes in species are measured over time to determine rates of change. Rates of use can be determined with counters installed at key points along a trail or, less comprehensively, by people tallying users.

Island managers may want to consult the following studies for a description of methods to use. The U.S. Forest Service's Backcountry Research Project has recorded the results of its research on Big Garden Island and Hurricane Island in *People and Islands: Resource Management for Islands in the Gulf of Maine (1984)*. The Appalachian Mountain Club described the approach used in its study of carrying capacity on Isle au Haut in *Interim Reports 2 & 3: Visitor Use and Impact Patterns on the Isle au Haut Acadia National Park* (1989). The Island Institute in collaboration with the Maine Island Trail Association will be developing a long-term system for examining recreational impacts of selected islands.

Sign directs visitors to Roque Island to a certain, limited part of the island.

Managing Soil and Vegetation Resiliency

Intensive management to prevent soil and vegetation loss is not yet a necessity on most Maine islands, and it won't have to be, at least in the next five years or so, if the islands are managed well as an overall system. This is the kind of cooperative venture that the Maine Island Trail Association is trying to achieve in encouraging its 2000 members to be good stewards of the more than 70 public, semi-public, and private islands available for use by its members.

For the more heavily-used islands, active management will be a necessity despite the best educational efforts. For instance, Monhegan Associates has learned techniques from the Appalachian Mountain Club that will help keep trail widths from being excessively widened. And the private owners of Butter Island in Penobscot Bay, a popular windjammer and cruising destination, are now using signs, brochures, and a caretaker to direct people to certain stopping places, camp sites, and trails.

Such management techniques are discussed below:

Encourage use where you want it and can manage it. It is important to establish acceptable patterns of use and behavior before many people discover an island so that as use increases, people will be in the habit of doing "the right thing". Once people get in the habit of using a particular site or using it in a particular manner, it can be very difficult and costly to get them to change.

Over the long term, the limits of resiliency are bound to be reached on many islands, especially on the more popular ones, as the number of small boat owners and windjammer charters on the Maine coast grow. For this reason, it is wise to use brochures, signs, and educational materials to direct people to the islands that are deemed most appropriate for recreational use. Only the more resilient islands should be targeted for use. Those with fragile ecosystems, sensitive plant and animal species and communities, landowners that do not welcome public use, and wildlife sanctuaries should not be publicized.

Plan to actively manage sites as use grows and direct people to use the parts of each island that are most resilient. When island use exceeds 100 person visits a year, specific sites for camping and other activities should be designated. Tent platforms, for instance, go a long way toward avoiding detrimental soil and vegetation loss. Signs directing people to the most resilient camp sites and trails on an island can be helpful in establishing healthy use patterns. On privately-owned islands that are open to public use, signs can direct visitors away from the parts of the island a landowner would like to keep private. Brochures and publications such as the Maine Island Trail Association member handbook can inform people about camping, waste disposal, and other techniques that conserve island integrity and landowners' good will. Harpswell has published a brochure that describes the special features of local islands and promotes their wise use.

Use a caretaker when signs of damage start to show. When vegetation and soil no longer rebound quickly from use, it is probably time to establish a caretaker on the island to ensure people use designated areas. Experience has shown that when such high levels of use are reached, there are usually enough users to pay for the cost of the caretaker through a fee system, according to Ray Leonard.

Driftwood camp on an island in the Muscle Ridge.

WILDLIFE

Limits and Threats

Coastal Maine is a highly productive biological environment, providing food and shelter for 150 species of marine-related birds and 26 species of marine mammals. This diverse assemblage includes seabirds, shorebirds, seals, wading birds, waterfowl, and raptors. Some species are considered rare or endangered; others are found in spectacular abundance; overall it is a resource considered to be of international, state, and regional significance.

Gull's nest on Little Brimstone Island.

Coastal wildlife is integral to Maine's character and heritage and it has contributed to making the coast a major tourist destination. Ironically, this outstanding resource is jeopardized by the use and development it has spawned.

The Maine Department of Inland Fisheries and Wildlife has primary responsibility for inventorying coastal wildlife resources and promoting appropriate management measures for adoption by state and local government and private land owners. In 1994 the Department of Inland Fisheries and Wildlife was in the midst of mapping coastal wildlife habitat for regulation under Maine's Natural Resources Protection Act. Since standards relating to the carrying capacity of individual

species are subject to change, this handbook emphasizes colonial nesting waterbird habitat by way of example.

Colonial waterbirds nest in groups called colonies. Four species of colonial seabirds and seven species of wading birds nest on Maine's islands.

The table to the right shows the estimated number of colonies and nesting pairs for these species. Four hundred fifty-two, or about 10%, of Maine's coastal islands and ledges have recent records of one or more nesting waterbirds. A partial list of these islands can be found in the Department of Inland Fisheries and Wildlife's *Coast of Maine Wildlife Management Area Plan,* (1991).

Seabirds prefer undeveloped, unforested islands. Most islands used by nesting waterbirds are relatively small. The outer coastal islands are superior for nesting because of their relative isolation from predators such as foxes, mink, and raccoons, but as use by recreational boaters and vacation home-owners has increased, conflicts between nesting birds and people are more frequent, even on the outer islands.

Development, human activity, and the pets, sheep and other predators introduced by people can destroy nesting habitat, expose eggs, adults and young to predation, and crush burrows and eggs. For this reason, many seabird island owners do not use them during the breeding season or choose not to develop their properties at all.

Just over half of the islands used by nesting waterbirds are owned by the state and at least 32 more are owned by other private or public conservation organizations. However,

Colonial Waterbirds on Coastal Islands

Species	1977		1991	
	No. of Colonies	Nesting Pairs	No. of Colonies	Nesting Pairs
Common Eider	241	22,390	325	30,176
Double-crested Cormorant	103	15,333	132	28,044
Herring Gull	223	26,037	258	23,176
Great Black-backed Gull	220	9,847	255	13,642
Arctic Tern	9	1,640	10	2,094
Common Tern	24	2,095	24	3,914
Roseate Tern	3	80	6	127
Laughing Gull	6	231	9	716
Atlantic Puffin	1	125	3	144
Black-headed Gull	0	0	1	1
Leach's Storm-petrel	17	19,131	18	19,411
Black Guillemot	115	2,668	132	2,776
Razorbill	2	25	3	75
Great Cormorant	0	0	4	29
Great Blue Heron	18	903	30	1,281
Black-crowned Night Heron	8	117	9	96
Glossy Ibis	3	75	2	134
Little Blue Heron	2	4	2	4
Snowy Egret	4	90	3	252
Tricolored Heron	1	1	1	1
Cattle Egret	0	0	1	2

Source: Island Nesting Colonial Waterbird Assessment, Maine Department of Inland Fisheries and Wildlife, 1992

many important islands remain in private ownership. A change in use of these private islands could jeopardize the health of the birds and their habitat. Birds on publicly-owned islands are also at risk when they are disturbed during the nesting season by campers, picnickers, and other boaters.

Indeed, one need only to look to the 19th century, when even gulls were in short supply in Maine, to see the impact that human exploitation and disturbance can have on these birds. The seabirds were displaced by human activity, impacted by sheep, and taken for meat, feathers, eggs, and even fish bait. Seabird populations dramatically declined in the 1800's when human populations on Maine islands peaked.

The status of several species of seabirds is currently precarious. Endangered species such as the Roseate Tern warrant special attention. The Arctic Tern, Leach's Storm Petrel, and Atlantic Puffin are being watched for signs of decline. Eiders, Herring and Blackbacked Gulls, and Doublecrested Cormorants seem to be doing well.

Limits. Wildlife biologists recommend a "rule of thumb" of no use by people or sheep during the nesting season because colonial nesting waterbirds can tolerate very little disturbance. In terms of carrying capacity, an island used by nesting waterbirds can accommodate little, if any, use and development during the nesting season. Keeping sheep on nesting islands poses a risk to waterbirds because the sheep can trample burrows, crush eggs, and destroy the higher grass and shrubs required by some species to conceal nests from predators.

Inventorying Waterbird Populations

Island landowners and communities should not conduct their own inventories of the numbers of colonial waterbirds nesting on their islands. Attempts at inventorying by an untrained person pose undue risks to the birds. The Department of Inland Fisheries and Wildlife has conducted baseline population studies that can be relied upon.

Managing Waterbirds and Other Wildlife Populations

The State of Maine's approach to managing wildlife is aimed at maintaining abundance and diversity. Endangered species such as the Roseate Tern are not the only concern. Habitat for all wildlife is important. In addition to protecting existing waterbird nesting islands, it is important to protect complexes of islands from development so the waterbirds and other wildlife will be free to move if necessary from one island to another as conditions change.

The State's Natural Resources Protection Act provides protection for certain wildlife habitat identified in the law as "significant." Among the protected resources are: endangered and threatened species; certain waterfowl and wading bird habitats; shorebird habitat; and seabird nesting islands. In 1994, the Maine Department of Inland Fisheries and Wildlife was preparing assessments and management plans for protecting these wildlife habitats of state importance, including guidelines for implementing the wildlife protection provisions of the Natural Resources Protection Act. The Department has identified 295 islands as significant seabird

nesting habitats. The Land Use Regulation Commission has special standards for seabird nesting islands. The Natural Resources Protection Act standards will be designed to complement the Land Use Regulation Commission's wildlife habitat protection initiatives.

State and federal regulations also protect the birds themselves. The regulatory arena is complex due to the overlapping jurisdictions of several levels of government. The Migratory Bird Treaty Act specifies the birds that can be hunted, (e.g. Eiders), and protects all but nuisance birds, such as starlings, from harm and harassment. It also requires a permit for activities, such as research, that may disrupt the birds. State regulations govern seasons and other matters pertaining to hunting Eiders, formulated within the guidelines provided by the federal government.

The federal and state Endangered Species Acts protect endangered and threatened species such as the Roseate Tern and Bald Eagle. Guidelines for protection of these species can be found in the Department of Inland Fisheries & Wildlife's *Atlas of Essential Wildlife Habitats for Maine's Endangered and Threatened Species,* and *Bald Eagle Management System and Data Base*. The guidelines for Bald Eagles limit incompatible uses within 660' of a nest occupied in at least one of the last three years. Lesser restrictions prevail in the zones from 660'-1320' and 1320'-2640' from the nest.

In addition to the protections provided by the regulatory process, many island owners and communities may want to take their own steps to protect the birds and their habitat.

Basically, management of colonial waterbird populations has four major objectives:

Protecting colonial waterbirds;
Minimizing loss of nesting habitat;
Limiting opportunities for disturbance during the nesting season; and
Avoiding the introduction of predators.

Protecting colonial waterbirds. Protecting the birds themselves using all of the regulatory and nonregulatory tools available should be a top priority. As discussed above, the regulatory arena is complex due to overlapping state and federal regulations. Local governments can protect habitat with restrictive zoning. Landowners can take nonregulatory steps such as posting their islands to warn visitors away from nesting areas.

Minimizing permanent habitat loss. Development or building is not appropriate on waterbird nesting islands, except in very rare cases where the nesting colony is located in a relatively small area of a very large island, and adequate visual buffers can be maintained to prevent disturbance. To find out whether an island's seabird population can tolerate any use or development, contact the Department of Inland Fisheries and Wildlife's Regional Wildlife Biologist assigned to your region.

Sheep are another consideration in limiting habitat loss, although their influence is more temporal than houses, docks, and roads. Free-ranging sheep turn Common Eider and Laughing Gull nesting cover into short grass that offers no protection, driving the birds into marginal habitat or off the island.

Limiting disturbance during the breeding season. Timing is everything with breeding waterbirds. Because the birds are so sensitive, even "low impact uses" such as bird watching and picnicking can flush them off their nests. Nesting begins around April 1. Many of the birds are done by July 15, but a few require more time. The amount and timing of seclusion depend on the island and species. Some waterbirds are still rearing their chicks into August. A prohibition against disturbance is equally important from the water where people should conduct their activities at least 1/4 mile off shore. Construction isn't advisable from March 1 through August 15. Eagles, by comparison, require a longer time period, from February 1 to August 31.

Avoiding the introduction of predators. Mink, raccoons, foxes, and other predators should not be introduced onto a colonial waterbird nesting island. Some people have done so inadvertently, thinking to rid their island of a pesty raccoon by transferring it to another island. The consequences are devastating to nesting birds. Cats and dogs should not be allowed to roam freely.

Many islanders have had their flower and vegetable gardens eaten by deer. Whether there are too many deer and how to limit their numbers is frequently a topic of animated conversation among islanders.

SCENIC QUALITY AND CHARACTER

Limits and Threats

The scenic beauty of the Maine coast is a national asset and islands provide much of the visual richness. Harvard researcher Carl Steinitz summed up the most important influences on people's visual preferences for the Mount Desert area. While the study was conducted for Acadia National Park, the results are instructive for rest of the coast. He found that Acadia visitors:

1. Do not like to see a "culturally modified", i.e. developed landscape, (with the exception listed in #3);
2. Seek a sense of mystery; they wish to be drawn further into the scene;
3. Like coastal development that is generic to the Maine landscape;
4. Like to see water;
5. Do not like to see tourist-oriented development;
6. Like distant views;
7. Like to see a "folded" landscape (one with a lot of edges and layers), typically mountains and islands; and
8. Like to see diverse and well-maintained vegetation distributed in the foreground and middle ground of a view.

With respect to islands, each one of us probably can think of a view that we hope will be there, unblemished, in perpetuity. We can probably also think of a spot where some development activity has marred a scenic place or view, such as a house on a prominent bluff, many houses strung along the shore, or a tall communication tower.

State mandated shoreland zoning now provides some protection of the shoreline by requiring that most buildings are set back 75 feet from the high tide line and by limiting the amount of tree clearing that can go on in the 250-foot strip along the shore. However, a town, a community or an individual island land owner can take additional measures to ensure that development is sited in a way that protects the natural appearance of islands, the shorelands, and the distinct boundaries of island settlements. Measures can also be taken to encourage development that reinforces island architecture and community values.

Limits. The Steinitz study mentioned earlier did not quantitatively explore how much of Maine's coastal landscape can be developed without detrimental effects. However, a study Greg Buhyoff and Doug Wellman published in the *Journal of Leisure Research* documents that "landscapes become 'aesthetically damaged' rather quickly, with the greatest impact expected within the first 10% of the area

changed." Their study shows that sometimes a little bit of development can have a rather strong and immediate effect on overall visual quality. Applying this rule of thumb to the Maine coast, if the goal for an island or complex of islands is retaining its remote, natural character, at least 90% should remain undeveloped, and highly intrusive new development should be avoided altogether.

Erv Zube's work, undertaken in the 1970s when he was affiliated with the University of Massachusetts, also provides guidance for islands where unspoiled, natural character is not the goal. His New England research showed that when more than 50% of a landscape appears developed with low density residential development, it no longer appears "rural" in character. A Yugoslavian study drew the same conclusion, and that much more surrounding open space is needed (70% or more) when development is more dense.

Inventorying Visual Carrying Capacity

Islanders and island stewards who are interested in inventorying their island's visual resources should consult the Department of Economic and Community Development's publication titled, *How to Conduct An Inventory of Scenic Areas*.

In inventorying an island's visual carrying capacity, one should especially consider the following:

1. **Existing screening capacity**, i.e. the likelihood that tree cover and/or terrain will screen development from view. Areas with gentler slopes and high, dense tree cover can screen development from view better than steeply sloping terrain with immature tree growth or no tree cover. The greater the slope and shorter the trees, the more likely a structure will be visible. The greater proportion of softwood in the tree cover, the more likely people won't be able to see the development even during the winter;
2. **Vegetation renewal potential**. Some islands will not support tree cover because of natural conditions such as wind, salt spray, and lack of adequate soil cover. While these islands are usually so small that development is precluded, development of the larger unvegetated islands would be highly conspicuous. In contrast, areas that are open because people or sheep have managed the vegetation can be allowed to revert back to trees to minimize the visibility of development. However, because people like the look of fields, as well as woods, sometimes it is desirable to maintain a diverse landscape.
3. **Visual exposure of the site to key viewing areas** (i.e. whether it can be seen from the water or public ways, trails and facilities). The community needs to decide which scenic areas are important. If the community wants to maintain a natural appearance from the water, then it should identify places on the island that can be seen from the water. For

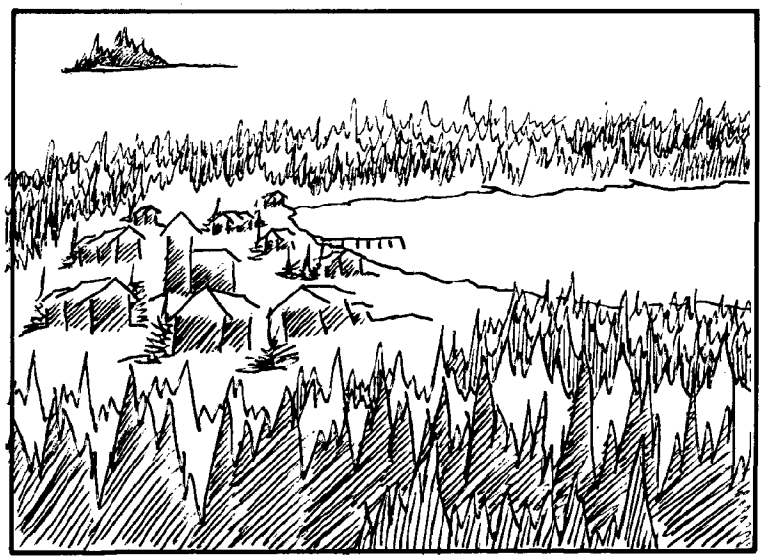
gently sloping islands, this is usually just the shoreland. A community should also consider whether to include in the inventory other landforms visible from the water . A community concerned about an island's character from the vantage point of those who drive or walk interior roads can map these "viewsheds" as well; and

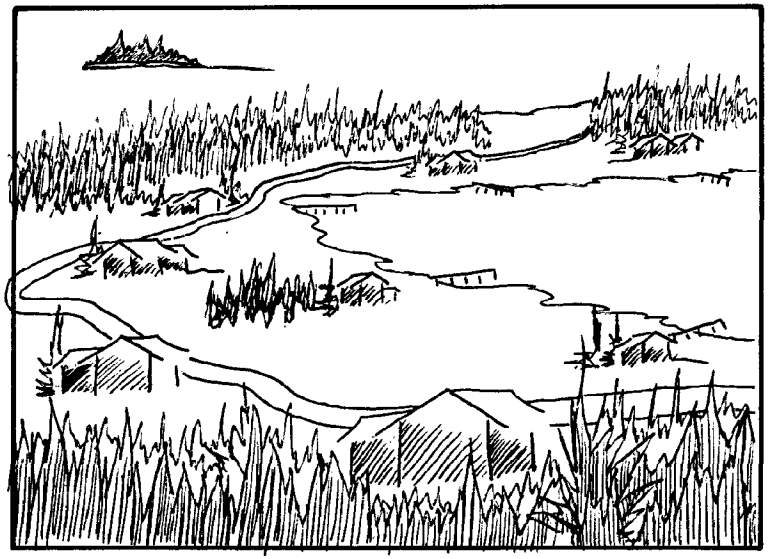
4. **Visual quality**, i.e. the degree to which an area is considered visually pleasing. Open fields, pronounced landforms, groups of islands, views of the water from island roads, and traditional architecture are just some of the more important features that can contribute to an island's visual quality.

Managing Visual Resources

Can the visual quality and unique character of the islands be protected without stopping development altogether? Three strategies offer ways to meet this challenge successfully:

Concentrate development where possible. Conventional development patterns tend to sprawl in grid fashion throughout a landscape. It's difficult to anticipate the ultimate effect on visual character because most development occurs incrementally, house-by-house. People get used to such change, a little bit at a time. But at some point, a place begins to take on a new character. An island that once felt unspoiled or remote, now begins to look just like any other developed landscape.



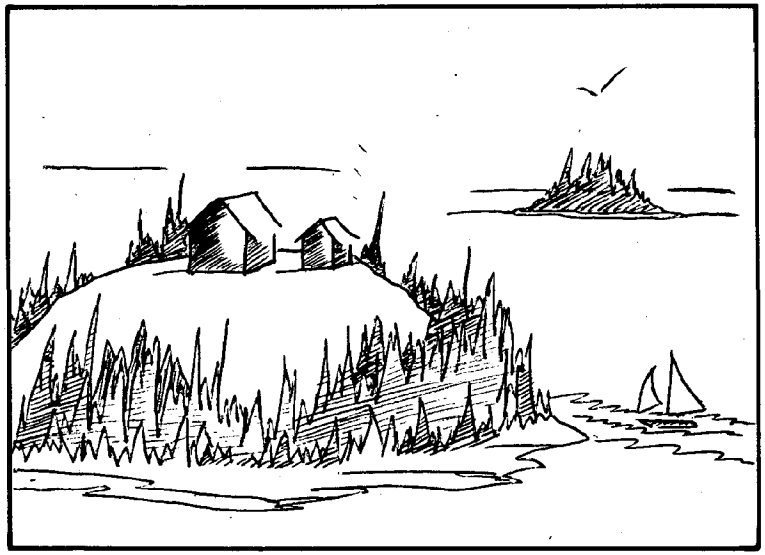


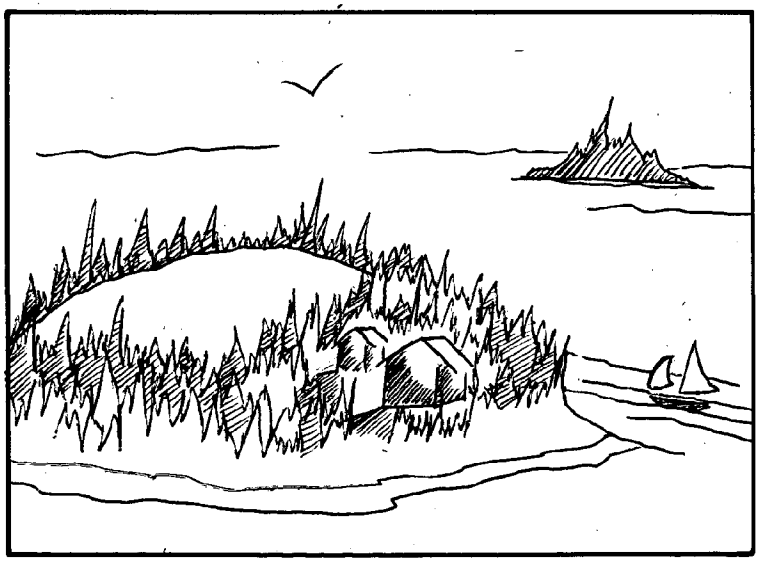
Concentrate development within or near existing villages, avoiding development that sprawls throughout the landscape.

Wherever possible, the most effective policy is to site development in pockets or within or near existing villages and settled areas of an island, to retain as much open space as possible. Many local ordinances include "growth areas" or clustering provisions to accomplish this objective. Ideally, decisions about which islands or parts of islands should be developed would be made as part of a regional process to identify growth areas for an entire bay or watershed. To retain a landscape with a remote undeveloped character, only a very small percentage of the total visible area should be developed, whereas a rural, developed character could sustain a little more development. In making policy decisions about visual character,consideration needs to be given to who the viewing audience is: boaters on the water, people exploring the land base of an island itself, island residents?

For some islands, dispersing development on large lots may be the best way to conserve other important values and sensitive resources. In any case, the development pattern needs to respond to an island's particular characteristics.

Develop areas with high potential for screening development from view and protecting scenic quality. Those who are planning the future of an island should look for the places that are most capable of hiding development from view, unless of course, the area to be developed is a village area or other place where the community wants development to be conspicuous. Villages and harbor waterfronts are usually highly visible but positive components of Maine's scenic beauty. Local land use ordinances can encourage development to locate in villages or areas where development will be the most inconspicuous.





Avoid building in places with high visibility from the water, instead build in areas with a high potential for screening new development from view.

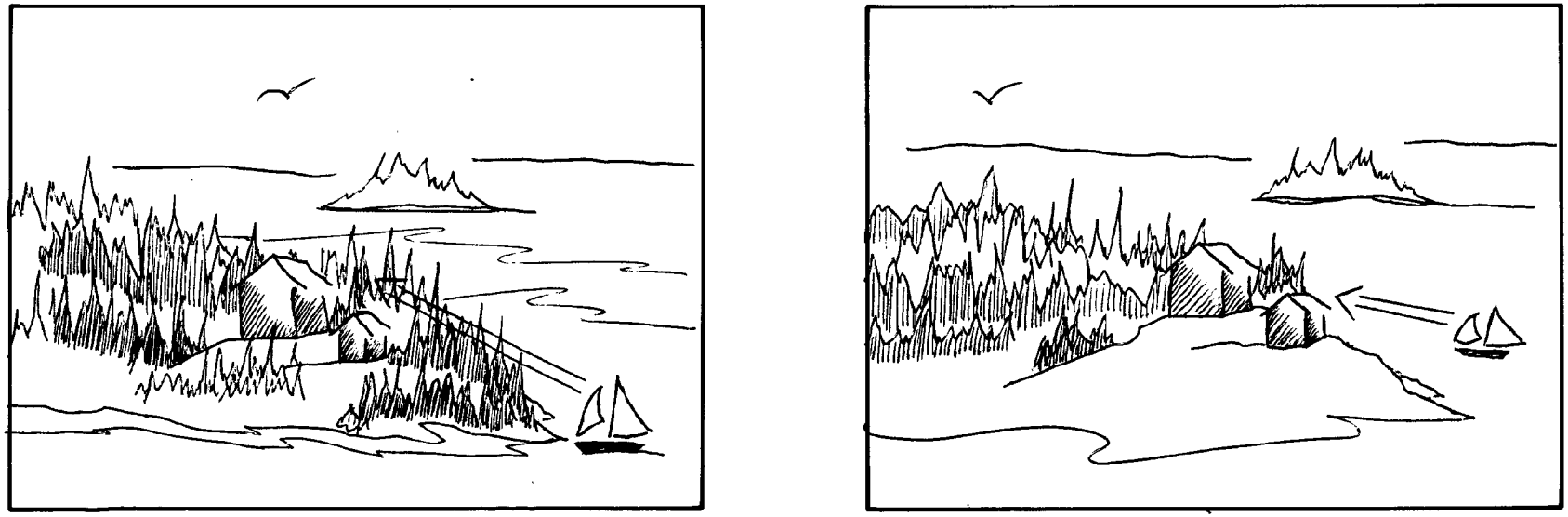
Screen development from view where a naturally appearing landscape is important. Even if development is located in a place with good screening it doesn't mean that the project will not be seen once it is built. A project can be designed sensitively to take advantage of the screening power of a site. For instance, building a road directly up a rise, might allow people to see it from the water, whereas, having the road traverse the slope along its topographic contours can hide it from view. Standards can be incorporated into local ordinances and Land Use Regulation Commission regulations that require:

1. Sensitive road and utility siting on slopes,

2. The retention of existing vegetation or planting of new vegetation in critical places to screen new development from view (currently, this is only a consideration in the 250-ft. shoreland area); and

3. Rooftops and other evidence of development to be sited below ridgelines and tree cover.

People who own an entire island or large property on an island don't have to wait for local or state government to protect the visual interests of their property. Private landowners can accomplish the same objectives through thoughtful subdivision plans, deed restrictions, and conservation easements.



Design development to take advantage of the screening power of a site, so that it will not be seen once it is built.

This prominent house on a North Haven bluff is a Penobscot Bay landmark, but if a new house were built on a similarly visible point, people would probably feel as though the value of a highly scenic place had been compromised. People can work with local government to inventory and protect such special places.

Swan's Island communication tower makes scenic impact

A 300-foot high transmitter tower, with FAA-mandated flashing red light, was recently installed on Swan's Island by a cellular phone company. Island residents have divergent opinions about the tower —some find it an unsightly blemish in their view, others are excited by the availability of improved communications technology. With no island-wide zoning, the tower did not require planning board approval. Similar towers have been proposed on other islands in recent years. In response to such a proposal, Islesboro adopted ordinance language limiting the height of towers.

In some communities there are not many scenic views of the water from public roads. Local governments or island communities may want to consider ways to protect views valued by residents. Protection techniques range from vegetation management, to conservation easements, to preserving open views (i.e., maintaining fields).

USING LIMITS TO DECIDE AN ISLAND'S FUTURE

This chapter attempts to describe a very difficult task—pulling together the study of each limiting factor into an overall carrying capacity analysis for an island, and turning that into a comprehensive island management strategy.

Island towns preparing a comprehensive plan and implementing ordinances as a part of Maine's Growth Management Program should be able to use this handbook as a tool in that process. Considerable information about comprehensive planning is available from the Office of Community Development in Augusta and from regional planning agencies. (See Appendix 5.) Those materials should be referred to for guidance on how to design a public planning process, supplementing the discussion that follows. Island communities under the jurisdiction of the Land Use Regulation Commission and people wishing to do an island plan at less than the town level may find the comprehensive planning materials useful as well.

Mainland towns with islands under their jurisdiction should also consider the carrying capacity of the islands when making decisions affecting their future use and development. The vast majority of Maine islands are part of a mainland town, but rarely are the islands' unique limits and values given consideration during the local comprehensive planning and ordinance-writing process.

Occasionally islanders' concerns are focused on only one resource or factor and the level of use that it can sustain, in which case the carrying capacity analysis can be very focused. The Island Institute has experience in preparing these more selective plans, and they can be consulted for help.

Putting the Factors Together

Several steps lead up to putting the factors together. Some of the steps are discussed here at length, and others hardly at all.

To initiate an analysis of an island's carrying capacity, someone—an individual or a group of people—needs to make a general assessment of the recent trends in use and development of the island, and the impact of those activities on natural resources and quality of life. Most likely, if there is interest in considering limits, there is consensus in the community that there is a problem. Defining the problem will direct the analysis.

This handbook focuses on one step of a process, analyzing levels of use and development that can be sustained by the six factors discussed in Chapter 2. However, that step must be one of several in a long-term planning exercise. Steps in that process would probably include: further assessment of the current situation; analyzing limiting factors; putting the factors together; deciding on solutions; and

Summary of Rules of Thumb

Groundwater Quantity:

1. Limit impervious surfaces to < 25% island
2. Islands 100 acres or more: maximum density of 1 acre per unit
3. Islands less than 100 acres: maximum density of 2.5 acres per unit

Groundwater Quality:

Saltwater intrusion

1. Islands 5 acres or more: maximum density of 1 acre per unit
2. Islands less than 5 acres: no development

Septage contamination (on-site well/septic):

1. Relatively flat islands with good soils: maximum density of 1.5 acres per unit
2. Islands with shallow/clay soils: maximum density of 3 acres per unit

Social Experience:

Remote recreational experience:

1. Number of "stopping places" multiplied by average party size = maximum daily use

Vegetation and Soil Resiliency:

Annual limits:

1. No impact on vegetation or soils if site visited by less than 100 people per year
2. Persistent decline expected if used by over 500 people per year
3. Active management needed if used by over 1000 people per year

Size of party:

1. No impact: 20 people over 3 days/ 25 visits of 2 people each using site for 2 days (sensitive sites)/50-100 parties of 2 people each using site for 2 days (resilient sites)
2. Visible effects: 100 people over 3 days/10 people over 10 days

Seabird Nesting Islands:

1. No development; if construction is necessary, avoid April 1-July 15
2. No sheep/almost no use by people 4/1-8/15

Scenic Quality:

1. Remote, "unspoiled" character desired: develop no more than 10% of island or island complex/no highly intrusive development
2. Rural character desired: develop no more than 50% of island/island complex

implementing them. Effort should be made to involve as many affected people as possible.

In addition to the analysis of limiting factors, such as those discussed in Chapter 2, it will probably be necessary to put some effort into quantifying the numbers of residents and visitors to an island. It is important to understand the characteristics of the people who are currently, or likely in the future, to exceed an island's carrying capacity—year-round. residents, people who own or rent seasonal homes, and transient visitors who come for the day or lodge or camp for a night or longer. In addition to the people who live on an island year-round and seasonally, planners need to know generically who and how many transient visitors there are, how they get there, why and when they come, and what they do while on the island. Methods for quantifying resident and visitors are discussed in Appendix 2.

Once analyses of factors that are most likely to stress an island's carrying capacity have been completed, the next step is to determine how they relate to one another. There is not one simple way to put the factors together because of the great variability among island circumstances. The table on the facing page summarizes the "rules of thumb" recommended for each of the issues considered.

Some of the key questions to ask when putting it all together are:

1. Does the island have development potential? If it is smaller than five acres or used by seabird nesting colonies then the answer may be "no".

2. If it has development potential:

   How much of the land is buildable and at what densities based upon water supply and subsurface sewage disposal? The table on page 64 discusses the value of conducting a buildout analysis. An explanation of how to do the analysis can be found in Appendix 3.

   What other natural or cultural factors alter the appropriateness of identified areas and densities? For instance, are there important wildlife habitats such as eagle nesting areas that should be removed from "buildable" status? What proportion of the island is developable and how does this amount/location stack up against the scenic quality rules of thumb?

   If all the buildable land were eventually to be developed, how would the island's social experience change? Would resulting densities enhance or threaten its traditional character? How would peak populations, including day trippers and other short- term visitors along with year-round and seasonal residents, make the place feel psychologically, i.e. comfortable, small and friendly, overcrowded, just like any other residential area?

3. If an island does not have development potential:
   What uses are appropriate?

   How much recreational use can its vegetation and soil withstand? Will that amount exceed the social carrying capacity of the island's recreational experience? Will recreational

uses threaten sensitive wildlife populations such as seabird nesting colonies?

These questions are meant to help direct the analysis that needs to be done to weave limiting factors together. There are many other important questions to answer, depending upon the island. For populated islands, fiscal limits will probably be an important factor to consider along with the others. Once this cross-cutting analysis is completed, a clear picture should evolve of how much use and development an island can withstand.

Developing Management Goals and Strategies

Some big decisions have to be made to make the leap from knowing what an island's carrying capacity is, to adopting measures to assure that limits are not surpassed. Usually this step in the planning process is described as setting management goals and adopting implementation strategies. These goals and strategies can direct the type and intensity of use and development to insure that an island's resources are sustained. Islanders need to decide what level of impact on drinking water supplies, seabird habitat, the character of the island's landscape, and other factors they are comfortable with. Communities also need to decide to what degree putting limits on use and development is acceptable. Finding consensus on goals and strategies that balance growth with resource protection is a challenge for any community.

A lot of dialogue needs to take place in a community to reach consensus on goals and to implement strategies for balancing growth with resource protection.

Island towns and mainland towns with islands under their jurisdiction have primary responsibility for local land use decisions. However, the state also has planning and regulatory responsibilities that affect island carrying capacity. For instance, the state is developing regulations to guide land use decisions on islands with habitats of state significance, such as colonial seabirds, under the Natural Resources

A build out analysis can help a community understand the long-range implications of land use planning:

Development can have a cumulative impact on an island's water resources, maintains Robert Gerber, a hydrogeologist who has conducted groundwater studies on several year-round and seasonally inhabited islands. This fact alone makes it worthwhile for an island to examine what level of development is enough.

On Vinalhaven, Gerber thought about this limit as he provided the town with a minimum lot size recommendation to ensure safe, clean and plentiful water supplies. He based his figure, which assumed maximum residential development, on the ability of island soils to absorb and filter septage. Another community might have other limits or tolerances they would not want to exceed as they think about minimum lot sizes. His recommendation for Vinalhaven turned out to be more restrictive than the current zoning, assuming maximum development. Vinalhaven has the opportunity to use Gerber's build out scenario in future deliberations about the island's land use ordinances.

On another island, concern about cumulative impacts led the community to identify acceptable lot sizes and growth and rural areas. Monhegan examined where building could still take place by going through a build out exercise. They identified buildable areas by eliminating developed areas, "wildland" areas where zoning precludes development, and environmentally constrained areas. When they looked at what remained, they identified two possible areas where they could encourage or direct growth. The community voted in favor of one of these areas, based on the proximity to the existing built community and the suitability for septic disposal. This was then approved by LURC, the agency that regulates land use on Monhegan. With the facts in hand, the community chose to favor development within an already developed area while protecting the rest of the island. To their advantage, 65% of the island is owned and protected by the Monhegan Associates. In other communities without a comparable amount of protected open space, there may be even more incentive to identify acceptable limits of growth based environmental, as well as socioeconomic conditions.

A build out provides baseline information for a community to consider when asking questions such as: what are our limiting factors and how do we want our community to look down the road? The theoretical analysis of maximum residential development and consideration of the related cumulative impacts can motivate a community to revise current zoning regulations affecting minimum lot sizes, setbacks, and resource protection zones, as well as identified growth and rural areas.

For more information on conducting a build out see Appendix 3.

Setting Management Goals

A carrying capacity analysis conducted for Isle au Haut by the Appalachian Mountain Club under contract to Acadia National Park offers a good example of management goals. Isle au Haut is a 6,700 acre island in Penobscot Bay with a year-round community of about 75 people. The park encompasses the southern half of the island, about 3,241 acres. A committee of island residents and park personnel developed the following management goals, selectively included and abbreviated here for simplicity:

Environmental conditions

Environmental protection should be the highest priority in the park section of Isle au Haut, with visitor experience having lower priority. Management activities will be adopted with the objective of nondegradation of the environment.

The environment should be primarily shaped by natural forces, and human activities should not be generally apparent to the average visitor.

The objective of preventing degradation of environmental conditions does not preclude trail maintenance or relocation, or other construction to manage visitors.

Endangered and rare species and their habitats will be protected.

Vegetation beside trails should generally not show the effects of trampling. Trail treadways may be defined and duff and organic soil worn away, but they should not be excessively wide or deep.

Impacts on the Town of Isle au Haut

In recognition of the town's desire to retain a resource-based economy and not develop a tourism-based economy, intensive visitor management will direct most Park visitors to the Park.

Social conditions

Visitors should be few enough in number that they can be spread out along the coast and have a sense of privacy.

Natural appearing shoreline vistas should be maintained.

Campground design should provide for a sense of privacy.

Isle au Haut in the context of Acadia National Park as a whole

Both experiences, visiting the undeveloped shoreline and visiting an island are special. In this context, Isle au Haut should be recognized as a remote area within the Acadia National Park system.

The national park setting on Isle au Haut is unusual to be sure, but the kind of thinking island residents and park officials did to set the tone of visitor use and management is helpful to all who plan the future of islands. Not only are the process and specific management goals illustrative, so is the thinking about how one island fits into the bigger picture, in the case of non-park islands, in the context of a bay or the Maine coast as a whole.

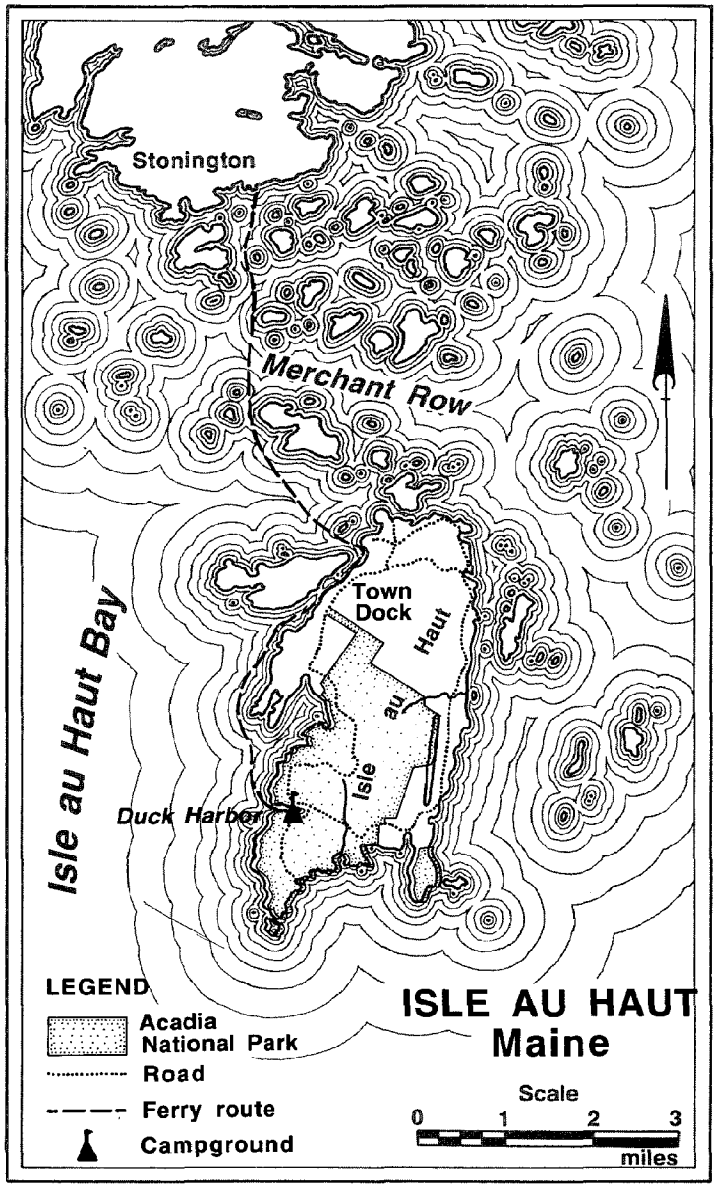
Protection Act. There are also decisions that individual landowners or island owners can make about the use, development, and conservation of their properties.

After goals have been set, management strategies should be developed and implemented to ensure the goals are realized. Many techniques can be applied to managing use and development of islands, but this handbook is not intended to explore each fully. Some are mentioned in Chapter 2 for each of the carrying capacity factors discussed. Others can be brainstormed through local committees, island landowner associations, and organizations and agencies willing to help.

Where development capacity of an island is concerned, one of the most important issues to consider is the ultimate land use pattern that is desired for an island. It is not enough to plan for an overall density. It is equally important to decide how that development will be distributed around the island. Which pattern is chosen should depend upon the island's particular limiting factors. It should also take into account the pattern and character of existing development.

Several ways to distribute development within the carrying capacity of an island are discussed below. However, this is not an exhaustive discussion of land use planning techniques. The state's Growth Management Program should be consulted for further guidance on state land use goals and planning assistance materials. (See Appendix 5.) Numerous publications on planning techniques are available commercially.

Traditionally, settlement patterns created tight-knit villages surrounded by much more sparsely settled rural

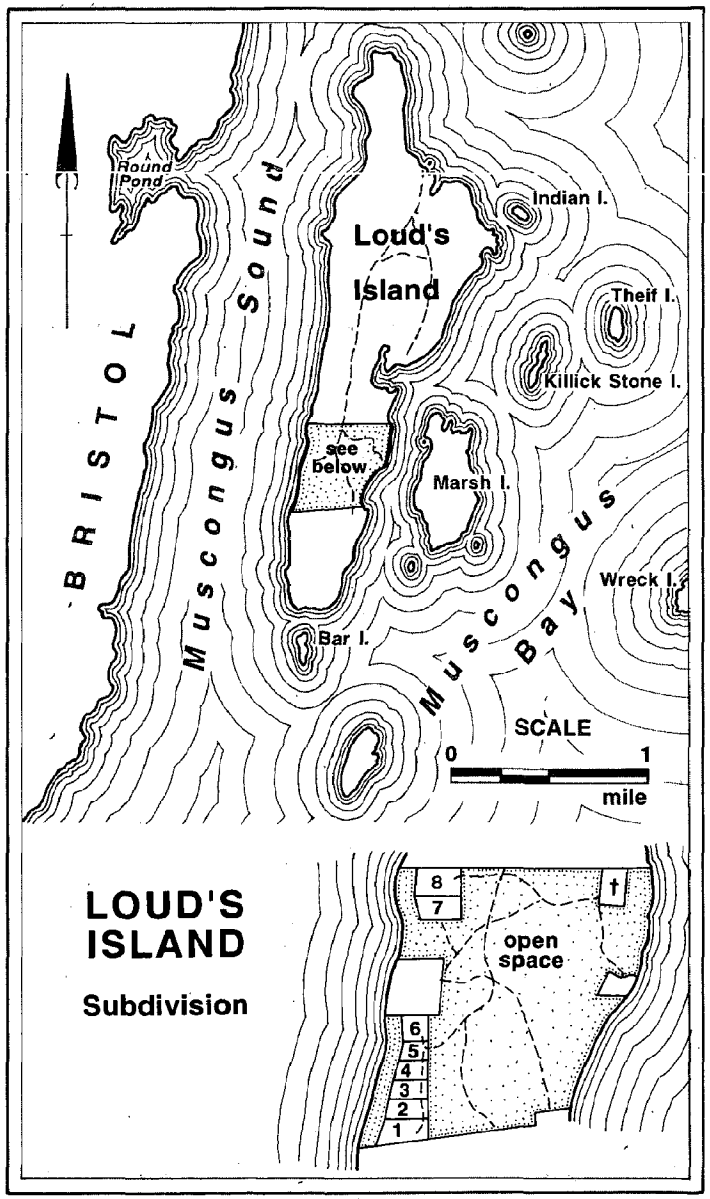


areas, even on islands. More recently, development has been spread throughout rural areas. Some people believe such dispersal will limit environmental problems, i.e. in regard to groundwater protection, dispersal will provide the greatest opportunity for infiltration and dilution of contaminants from septic systems. But this viewpoint only considers one aspect of carrying capacity. Alternatives exist to suburban-style, grid-like subdivision of land, alternatives to protect what people value most about an island.

Site development in one or more new pockets. If island pockets of development are sited carefully , shoreland character can be retained, sensitive habitats avoided, and the psychological benefits of open space maintained. The approach makes it easier to share wells, septic systems, docks and to take advantage of the best locations for each. It also reduces the number of roadways and utilities that must be built and maintained, thus reducing costs.

Louds Island development protects 88% of the project as open space:

A development recently permitted by the Land Use Regulation Commission will concentrate eight lots, ranging in size from one to 2.3 acres, in two pockets on Louds Island in Muscongus Bay near Bristol's Round Pond. The subdivision places all of the shoreland and much of the interior, amounting to 94 acres, under a conservation easement prohibiting future development. The lots are located on the most favorable soils of the property, some distance from significant coastal wildlife resources on the site, and in a manner that will screen them visually from the ocean and island public ways. The 106-acre project comprises almost 13% of the 825-acre island, where 30 seasonal residences already exist.



Site development in or near existing villages or neighborhoods. There is a functional appeal to living in a village—people like having neighbors nearby and being able to walk a short distance to the harbor, post office or store. There is also an aesthetic appeal—people feel comfortable with the scale and arrangement of buildings and streets and the unique landmarks of village settings. The pull that places like Monhegan and Carver's Harbor on Vinalhaven have in attracting visitors, and the many paintings of them, attest to their experiential quality. Directing growth to existing villages and settlements provides other benefits as well, such as protecting natural resources, scenic quality, and open space in outlying areas.

Sewage disposal and water supply are major stumbling blocks for concentrated development—as are sometimes local regulations prescribing large lot development. The cost of providing centralized sewage treatment is usually too high for the small populations of Maine's islands. Innovation is needed in this area to apply alternative technologies to small collection systems. Also, it can be difficult to find water supplies with high enough yields to serve a community system. Monhegan and Vinalhaven are fortunate to have such supplies.

Attitudes are another stumbling block. Even though they like the feel of village neighborhoods, having privacy or owning land on the coast is more important to many people. Open space and privacy can be designed into village areas to offset these potential drawbacks.

Performance-based zoning is key to sound development where intensive development is not appropriate around existing villages:

The main islands of Harpswell may be connected to the mainland by bridge, but the town faces problems similar to the offshore islands, only more intensively. The community is composed of three large and narrow islands and one long peninsula, connected by four bridges and surrounded by 47 outer islands. Finding appropriate spots where growth will be encouraged was one of the most difficult challenges of the community's 1993 update of its comprehensive plan.

The town finally settled upon a strategy that requires development densities and site layouts to adhere to the carrying capacity of individual sites, with a minimum lot size of two acres per unit set for all subdivision lots. The town's Future Land Use Map identifies the most suitable locations for growth. The Comprehensive Plan proposes many policies and implementation strategies aimed at encouraging development to locate within these areas, with more stringent restrictions aimed at development sited elsewhere. Most of the outer islands will be zoned for Resource Protection.

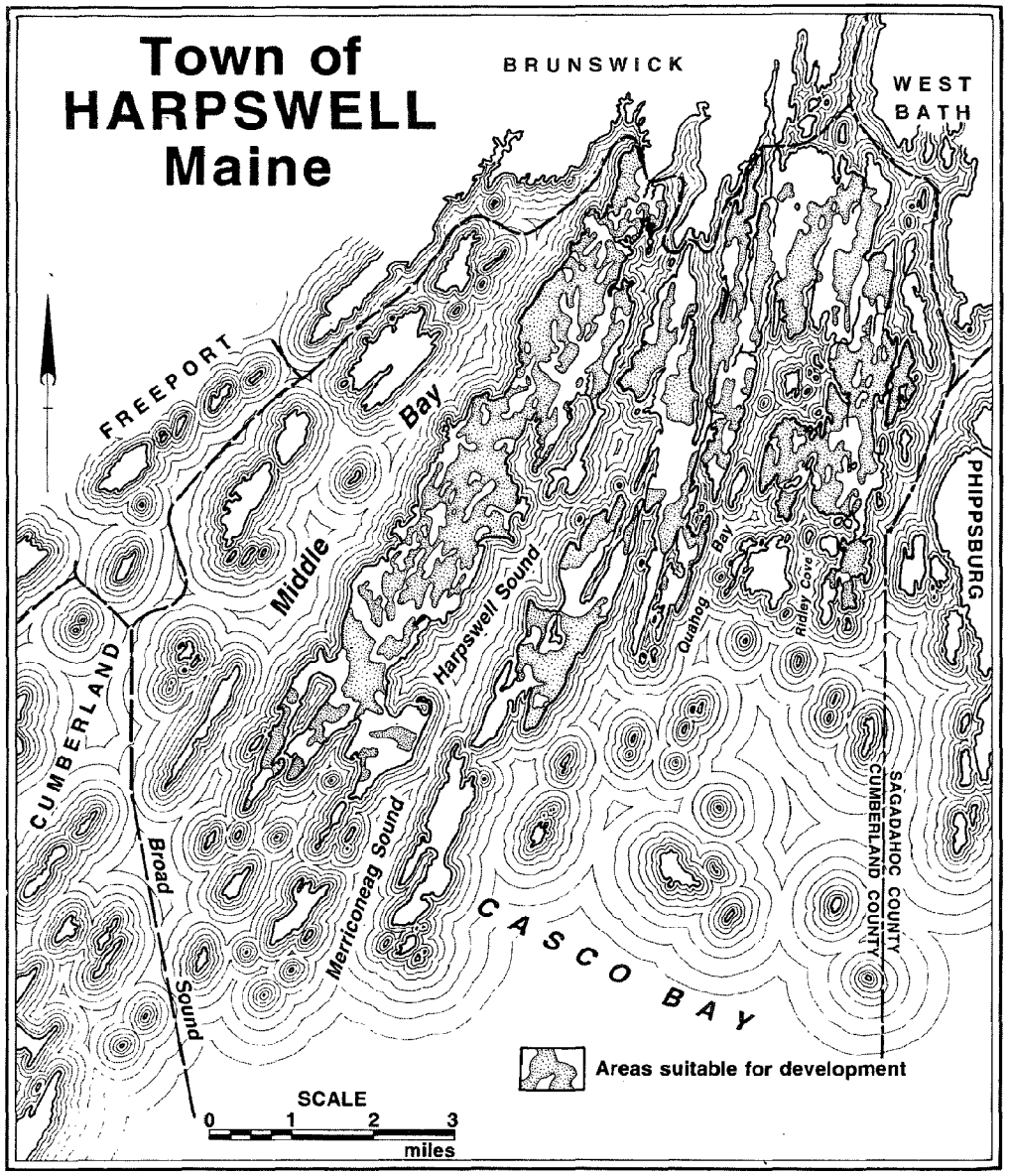
See map, page 70.

Develop sparsely or not at all. Some islands are not appropriate for much, if any, development. Many are too small to yield a source of potable water, given the risk of saltwater intrusion. Others, usually small as well, provide habitat for species that require isolation from people during the breeding season.

Monitoring and Adjusting the Management Strategy

Once a town or landowner has adopted and put in place an island management strategy, it is important to periodically monitor the results to make sure it is working. Are use or development levels creating impacts beyond the acceptable limits of change to which people have agreed? If conditions change, then perhaps the management strategy needs to change.

Groundwater quality, seabird nesting success, scenic quality, trail and vegetation erosion, and visitor/islander satisfaction with the island "experience", among other factors, can be tracked. The choice of indicators to monitor should be based upon: which are directly observable, relatively easy to measure, related to management objectives, sensitive to changes in conditions, and amenable to management.



Jordans Delight "boathouse."

Structure is built on Jordans Delight, an island that supports 2% of state's 2,660 nesting pairs of black guillemots:

This 28-acre Washington County island in Harrington is a highly significant seabird nesting area, supporting the rare Leach's storm-petrel and black guillemots, as well as eiders, gulls and cormorants. According to Margaret Anderson, the manager of nearby Petit Manan National Wildlife Refuge, the island is perhaps the largest nesting ground on the east coast for black guillemots. For this reason, the island appears on Maine's Register of Critical Areas.

A structure was built there in 1993 by the island's owner and a permit to build a wharf was filed with DEP, raising questions about the appropriateness of developing an island with such high ecological value and the effectiveness of state and local habitat protection measures. In an uncommon, but not unique, twist, the town of Harrington did not have Jordans Delight on its zoning maps at all, and so no resource protection was provided at the local level.

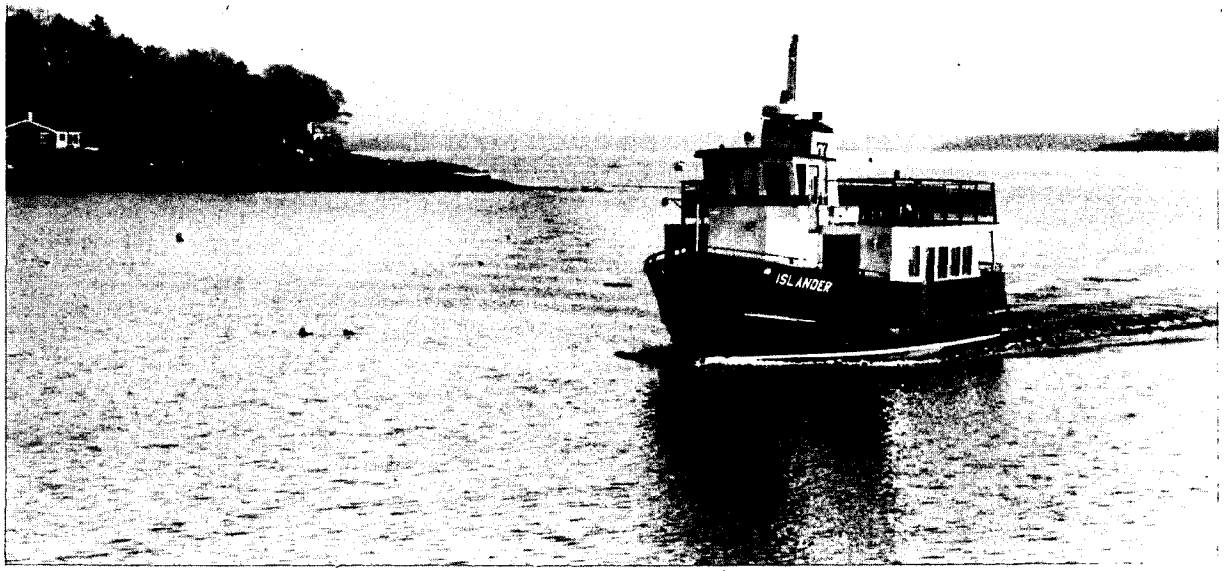
"Significant wildlife habitats" are listed as resources to be protected by the State's Natural Resources Protection Act. Until these habitats are mapped, and the maps are approved by the Board of Environmental Protection, habitat cannot be considered in the regulatory process, except when it exists in conjunction with another protected resource, such as a wetland. When the mapping is completed, probably sometime in 1994, all or part of Jordans Delight may be designated as a significant "seabird nesting island" providing protection for the seabird habitat in the face of future development proposals.

On some Maine islands it may be several years before there is the political will to set limits. In such a case, monitoring existing conditions to detect trends is especially important, so that discussions about what to do can be based upon fact rather than perceptions.

It's Time to Act!

Those qualities that typify island life often work against planning for their protection. The continuing accommodation to weather, the reliance on boat travel, the enduring nature of their island's rockbound shore tempt year-round island residents to believe that human impacts are insignificant in comparison to the forces of nature. The sense of isolation, proximity to wildlife, and the relative quaintness of island communities lull summer visitors into a false sense of security that their island will never change. However, to be complacent about the future of the islands will put them at risk; island wildlife, water supplies, environmental quality and community character are subject to limits rarely experienced on the mainland.

It is the responsibility of all—residents, visitors, municipal, state and federal officials—to exercise stewardship of Maine's islands. With this book as a guide, those concerned about the future of the islands can begin to lay the foundation for protecting the qualities that make Maine's islands special places to live, work or visit.



Appendix 1

Islesboro Sanitary Survey Form & Lincolnville Plumbing Inspection Policy

SANITARY SURVEY

Property Owner _____
Mailing Address _____
(& winter, if you're seasonal) _____
Local Address _____
Phone _____ Tax Map & Lot Number _____
Type of Structure (circle one) Year-round dwelling Seasonal dwelling
Business Other _____
Number of bedrooms, lofts, or other sleeping areas- 1 2 3 4 5 6
Number of restrooms/bathrooms 1 2 3 4
Do you have plans to expand your building or convert it to year-round use?____
If so, when _____

Wastewater Treatment Information

What type of disposal system do you have? (Circle one)

Pit privy	Incinerating toilet
Holding Tank	Composting toilet
Septic tank only	Cesspool only
Septic tank + Cesspool	Straight pipe
Septic tank+leachfield	Overboard discharge
Unknown	Other _____

Date the system was installed 19____ Unknown_____
What is the tank made of? (circle one) Steel Concrete Fiberglass
Plastic Unknown
How often do have the tank pumped?_____
When was the last time the tank was pumped?_____
Distance of tank from waterbody (lake, pond, stream, wetland)_____
Distance of leachfield or cesspool from waterbody_____
Distance of privy from waterbody_____

Possible Problem Symptoms

	Occasionally	Frequent	Seasonally
Slow draining fixtures in house:	_____	_____	_____
Wastewater backup in house:	_____	_____	_____
Odors	_____	_____	_____
Liquids ponding in yard:	_____	_____	_____

Other problems (explain):_____

Water Supply Information

Type of water supply (circle one): Drilled well Dug well Lakewater
Have you had problems with water quality (color, odor, taste,etc.)?_____
Has your water ever been tested and shown any contamination?_____
Distance of well to septic tank _____
Distance of your well to neighbors septic tank _____

Comments: (please write on back)

Islesboro Sanitary Survey

Appendix 1—Lincolnville Plumbing Policy

TOWN OF LINCOLNVILLE
PLUMBING INSPECTION
POLICIES AND PROCEDURES #1

PURPOSE: The quality of water in the Town of Lincolnville, available for domestic and recreational uses, is of great concern to the Lincolnville Board of Selectmen. To ensure that the quality of this water meets or exceeds the federal and state mandated standards, the Town contracts with a State of Maine Licensed Plumbing Inspector (LPI). This LPI is charged with the responsibility to operate within the plumbing guidelines established by the State of Maine.

POLICIES AND PROCEDURES: In addition to those policies, rules, and regulations set forth by the State of Maine, the Selectmen have directed the LPI to require each person, property owner or agent for the property owner, applying for an HHE 211, Internal Plumbing Permit, to first submit the septic waste facility serving the structure on the property to a LPI-administered dye test to prove that the septic system is not malfunctioning. If the tested septic facility fails the dye test, the property owner must make appropriate repairs before receiving the Internal Plumbing Permit. The LPI may waive the dye test requirement if the property owner can supply proof, in the form of an HHE 200, Subsurface Wastewater Disposal System Permit, showing that the system has been installed since January 1, 1980, in compliance with the State of Maine Rules and Regulations. The design factors must meet or exceed the proposed usage requirements. The fee for the performance of the dye test will be reviewed and set each year by the Selectmen and will be paid to the LPI performing the dye test.

REPLACES - All previous policies and procedures with the same specific subject

APPROVED: December 4, 1987

Richard MacLaughlin
Chairman, Board of Selectmen

Lincolnville Plumbing Inspection Policy

APPENDIX 2

Quantifying Resident and Visitor Populations

The survey methods described below can be used to help figure out how many people are living on or visiting an island. This information is especially important for managing use by transient visitors.

Year-round and seasonal residents: Most island communities keep track of the number of year-round residents. If the information is not available locally, most of the state's larger libraries and some regional planning commissions have U.S. Census data and other population estimates and projections compiled by the Department of Human Services. The Census or local property tax listings can be used to determine the number of seasonal homes in the community, from which a rough estimate of seasonal residents can be developed, based upon an assumption about how many people stay in each dwelling and for how long.

Overnighters: This category can be estimated for those islands with licensed motels, hotels, bed and breakfasts, and camping establishments. If this information is not already available, it can be compiled with the help of one of the following sources:

1. **Local Code Enforcement Officer**. If building permits have been issued for island establishments, the code enforcement officer may be able to provide a list of the lodging and camping facilities and the number of beds/sites in each. Contact these establishments directly to determine their annual counts or to obtain their estimated occupancy rate. Or estimate the total number of overnighters using a state-wide vacancy rate. Also, ask each establishment how many seasonal workers from the mainland they house and employ. If information is available about how many establishments/beds were on the islands in the 1970s, trends can be established using factors from a 1970s Arthur D. Little & Co. study. The study estimated 2.5 people per room with a state-wide occupancy rate of 60-70%.

2. **Division of Health Engineering, Maine Department of Human Services**. The Division licenses about 70% of the motels, hotels, bed and breakfasts, campgrounds, cabins, and other lodgings in the state. The Division (287-5671) can provide a computerized list of establishments for the town or township in which an island is located and the number of rooms/sites listed for each. If the island is part of a mainland community, figure out which of the listed establishments are on the island. The inspector assigned to the region can provide additional help, if necessary. He or she has specific knowledge of each licensed establishment. Again, an occupancy rate will have to be estimated.

Campers: Isle au Haut can obtain information from Acadia National Park about the number of campers who stay on the island during the year. Collecting camper information for other islands will not be so easy unless there is an established campground operated by the state or licensed with the Division of Health Engineering. Landowners may know how many camp overnight if users are in the habit of asking permission, as many do at Richmond Island in Cape Elizabeth. If not, an estimate could be based upon information about island recreational use currently being collected by the Maine Island Trail Association.

Daytrippers: If an island is served by ferry, develop a survey and estimate the number of daytrippers that visit using the method described below, suggested by Richard Sherwood at the State Planning Office. Private ferry companies may not want to participate because of the proprietary nature of the information. A survey will not only help determine the number of daytrippers, but also the number of people who lodge, rent cottages, live on the island, or come intermittently for other reasons.

There are three steps to the process:

1. **Develop a questionnaire**. Information to collect through the survey includes:

   a. Where people are coming from;
   b. How many people are in each party;
   c. The purpose of their trip;
   d. How long they stay;
   e. What island activities they engage in and where, i.e. hike, bicycle, visit art galleries, eat at restaurants, stay with friends/lodging; and
   f. Other information of interest to the community (see Chapter 2, Social Experience).

2. **Select sample dates**. The sample dates selected will depend upon whether peak use of an island or its total seasonal use is of greatest interest.

   a. **Total seasonal use**. First divide the season into three parts, perhaps April-June, July and August, and September-November, depending upon the island and its use. If daytrippers are of greatest concern, sampling only the July-August period may be sufficient. Group the months according to the number of daily ferry trips to make extrapolation of the results easier. Then divide each week into two parts, perhaps Friday-Monday and Tuesday-Thursday. Randomly select one weekday segment and one weekend segment for each of the three seasonal divisions. For instance, one may have selected the weekdays of the first week in June and the weekend of the third week in April for the spring sample, and used a similar approach for the summer and fall samples. These six samples will be large enough to estimate total seasonal use.

   b. **Peak use**. If knowing the most intense use an island gets at peak times is the priority interest, select the weekend or week when ferry ridership is greatest. This information can be obtained from the ferry service.

3. **Select boat trips**. Decide whether to survey all or just some of the boat trips that are made to the island on the dates selected. Every trip doesn't have to be included to get a good sample, but the more trips included, the better the estimate will be. If there are 16 trips to the island over the weekend segment, randomly select a couple from the busiest part of the day.

4. **Conduct the survey**. Arrange for some "volunteers" to help conduct the survey. Four to ten interviewers will be needed, depending upon the size of the boat, length of the trip, time of year, and how the survey is administered. Ideally, the interviewers would be on the boat, circulate among the passengers, and complete a survey for each party/person on the trip. Alternatively, a questionnaire could be given to each person/party as they get on the boat, and collected when they disembark.

5. **Extrapolate results**. To calculate seasonal use, first multiply the average number of daytrippers/trip in the weekday or weekend sample by the number of boat trips/segment, by the number of segments in the season. Sum the total for both weekend and weekday segments to get total use for each season; sum all of the seasons to get the total for the year.

Appendix 3

Methodology for a theoretical build out study

One way to catch a glimpse of an island's future is to analyze how land use decisions made today will affect an island's landscape over the long-term. This is done theoretically and is called a build out study. Such a study assumes maximal development potential for every buildable lot, and calculates the number of possible residences under this assumption. It reflects a worst case scenario, probably not what will actually happen. However a build out analysis can provide useful information for discussions about use of resources, limits of growth, and carrying capacity.

Methodology:

1. Determine area to be studied: a watershed, a proposed development site, an entire island. A parcel map and a topographic map are needed for this exercise. All information should be mapped for visual presentation, and data compiled for numerical analysis.

2. Determine built and unbuildable acreage.

Built acreage: Refer to the tax commitment book to identify all lots within the study area that have buildings on them. Map these on the parcel map. Further refinement can be added by noting separately lots which can be subdivided under current zoning and those which cannot be further subdivided. Total built acreage is calculated by multiplying minimum lot size(s) by the number of built lots. This will give you an estimate because not all lots will be the same size.

Unbuildable acreage: Of the remaining undeveloped land, determine how much land cannot be developed because of natural constraints, legal constraints, or zoning restrictions. Natural constraints include flood plains, wetlands, poor soils, steep slopes, and wildlife habitats. In addition, conserved lands, which restrict development through ownership, should be included. Map these areas on a topographic base map. Other zoning restrictions and conservation easements can also be mapped. Acreages for all of these should be tallied separately, and then totalled.

3. Determine buildable acreage. The land that remains after the built and unbuildable land are subtracted is the buildable acreage, which can be considered for development through subdivision, as grandfathered lots, or outright. Overlays of the development constraints, mapped on the topographic base map, and the existing development mapped on the parcel map, need to be combined, somehow, on the same map to show where development could occur in the future. For lots requiring roads to facilitate their development, 15% of the land area can be subtracted from the buildable acreage for right-of-way and utility construction. The remaining acreage is then multiplied by the minimum lot size to determine the maximum number of houses that can be built.

This information, used by a community during their planning process, unveils whether the current zoning adequately addresses the community's ability or desire to respond to maximum growth. In reality each parcel considered "developable" would be evaluated individually to determine suitability for house, septic, water, etc.

Appendix 4 — Population, Housing & Ferry Ridership Tables

Figure 1. Population of Year-Round Island Communities

	Area SQ KM[1]	Year-round Population 1990 Population	1980/84[2] Population	% Change 1980-1990	1990 Persons SQ KM
Cumberland County					
Cliff Island	1.21	87	90	(3%)	71.96
Chebeague Island	8.60	337	350	(4%)	39.17
Cushing and Peaks Island	4.14	775	1002	(23%)	187.11
Long Island town	3.20	201	140	44%	62.81
Lincoln County					
Monhegan plantation	2.22	88	109	(19%)	39.60
Knox County					
Isle Au Haut town	32.83	46	57	(19%)	1.40
Matinicus plantation	4.15	67	66	2%	16.14
North Haven town	30.15	332	373	(11%)	11.01
Vinalhaven town	65.58	1072	1211	(11%)	16.35
Waldo County					
Islesboro town	36.92	579	521	11%	15.68
Hancock County					
Cranberry Isles town	8.23	189	198	(5%)	22.98
Frenchboro town	12.47	44	43	2%	3.53
Swans Island town	36.15	348	337	3%	9.63
Total		4165	4497	(7%)	

1. *U.S. Census Bureau, 1990.*
2. *Portland Islands: Portland Islands Land Use and Zoning Study, Greater Portland Council of Governments estimates 1984; all other islands: U.S. Census Bureau, 1980.*

Figure 2. Housing on Year-Round Island Communities

	Total Housing Units			Vacation Homes		
	1990	1980/84	Percent Change 80/84-90	1990	1980	Percent Change 80-90
Cumberland County						
Cliff Island	151	141	7%	101	NA	
Chebeague Island	420	NA	--	268	NA	
Cushing and Peaks Island	805	882	(9%)	447	NA	
Long Island town	296	286	3%	202	NA	
Lincoln County						
Monhegan plantation	147	151	(3%)	105	98	7%
Knox County						
Isle Au Haut town	136	113	20%	116	84	38%
Matinicus plantation	101	99	2%	70	30	133%
North Haven town	441	378	17%	303	222	36%
Vinalhaven town	1038	994	4%	551	488	13%
Waldo County						
Islesboro town	636	586	9%	341	302	13%
Hancock County						
Cranberry Isles town	325	292	11%	234	137	71%
Frenchboro town	53	46	15%	27	26	4%
Swans Island town	385	342	13%	208	157	32%
Total	4934	4303	15%	1857	1544	20%

Source: Portland Islands 1984: Portland Islands Land Use and Zoning Study, Greater Portland Council of Governments. All other data: U.S. Census Bureau.

Figure 3. Maine State Ferry Service Ridership
(July 1, 1981-June 30, 1982 through July 1, 1991-June 30, 1992)

	Number of passengers		% change	Number of vehicles		% change	Number of bicycles		% change
	1992	1982	82-92	1992	1982	82-92	1992	1982	82-92
Vinalhaven	94,096	68,429	38%	21,965	16,779	31%	2,576	1,233	52%
North Haven	43,533	28,827	51%	11,173	7,571	48%	1,126	637	77%
Islesboro	177,770	115,026	55%	85,896	50,193	71%	3,061	1,593	92%
Swans Island	64,151	45,998	39%	23,347	17,129	36%	2,313	1,230	88%
Frenchboro	2,530	2,530	---	1,058	807	31%	1	8	(88%)
Total	382,165	260,810	47%	143,492	92,479	55%	9,077	4,701	93%

Note: The Ferry Service was extended to Matinicus in 1985. The number of passengers declined from 138 to 85 per year (through 1992); and the number of vehicles declined from 109 to 53.

Source: Maine State Ferry Service

Figure 4. Casco Bay Lines and Casco Bay Island Transit Ridership

	Number of passengers April 1 - March 30		
	1991-92	1982-83	% change 1982-83 to 1991-92
Peaks Island	505,564	409,119	24%
Little Diamond	15,245	13,479	13%
Great Diamond	20,051	14,800	35%
Long Island	85,691	56,376	52%
Chebeague	11,181	10,462	7%
Cliff	23,674	20,789	14%
Total	698,436	525,025	33%

Source: Casco Bay Island Transit District

APPENDIX 5

Selected Contacts and References

A. ISLAND CARRYING CAPACITY/ LAND USE PLANNING

Lead Agency Contacts:

Katrina Van Dusen, Maine State Planning Office, 287-3261

Fran Rudoff, Department of Economic & Community Development, 624-6800

Annette Naegel, Island Institute, 594-9209
John Bubier, Greater Portland Council of Governments, 774-9891
Tom Martin, Hancock County Planning Commission, 667-7131
Pat Jennings, Mid-Coast Planning Commission, 594-2299

Key references:

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B. GROUNDWATER

Lead Agency Contact:

Marianne DuBois, Department of Environmental Protection, (groundwater protection) 287-3901
Pam Parker, Department of Environmental Protection (overboard discharge program) 287-3901

Key references:

Dutram, P.W. 1988. *The Planning Process for Local Groundwater Protection*, Ground Water Standing Committee, Land and Water Resources Council.

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C. SOLID WASTE

Lead Agency Contact:

Rachel Therrien, Maine Waste Management Agency, 287-5300

Key References:

Caniff, Julie Ann. 1991. *Solid Waste Management for Maine's Outer Islands*. The Island Institute.

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D. SOCIAL EXPERIENCE

Lead Agency Contact:

Cate Cronin, Maine Island Trail Association, 596-6456

Key References:

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E. SOIL AND VEGETATION RESILIENCY

Lead Agency Contact:

Annette Naegel, Island Institute, 594-9209

Key References:

Conkling, P. W., R. E. Leonard, and W. H. Drury. 1984. *People and Islands: Resource Management For Islands In the Gulf of Maine*. Island Institute.

F. WILDLIFE

Lead Agency Contacts:

Steve Timpano, Department of Inland Fisheries and Wildlife, 287-5252

Gary Donovan, Department of Inland Fisheries and Wildlife, 287-5252

Sue Gawler, Maine Natural Areas Program, Dept. of Community and Economic Development, 624-6800

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G. SCENIC CHARACTER

Lead Agency Contacts:

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April 1994

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